SOIL VAPOR EXTRACTION PILOT STUDY REPORT VERSION 3.1 MOTOR POOL AREA ROCKY MOUNTAIN ARSENAL

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13. ABSTRACT *(Maximum 200 words)*
THIS SOIL VAPOR EXTRACTION PILOT STUDY REPORT FOR THE MOTOR POOL AREA AT THE ROCKY MOUNTAIN ARSENAL IS BEING PREPARED AS PART OF THE INTERIM RESPONSE ACTION. THE RECOMMENDED ACTION AT THE MOTOR POOL AREA WAS TO ADDRESS CONTAMINATED SOIL WITH IN SITU SOIL VAPOR EXTRACTION AND TO ADDRESS CONTAMINATED GROUNDWATER. THIS DOCUMENT PRESENTS THE RESULTS OF THE SOIL VAPOR EXTRACTION PILOT STUDY CONDUCTED BETWEEN JULY AND DECEMBER, 1991 AT THE MOTOR POOL AREA.

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1.0
INTRODUCTION

This Soil Vapor Extraction Pilot Study Report for the Motor Pool Area at the Rocky Mountain Arsenal (RMA) is being prepared as part of the Interim Response Action (IRA) process in accordance with the Federal Facility Agreement and the Technical Program Plan. Determinations concerning the implementation of this IRA have been reached through a consideration of the objectives of Sections 2.3(a), 22.5, and 22.6 of the Federal Facility Agreement and by application of the Decision Flow Chart for Other Contamination Sources IRAs adopted by the Organizations and the State in the June 7, 1989 Subcommittee meeting (WCC 1990).

An alternatives assessment was conducted as part of the IRA process in the fall of 1989. The recommended action at the Motor Pool area was to address contaminated soil with in situ soil vapor extraction and to address contaminated ground water through the use of a pump and treat system in conjunction with a Shell-led IRA which addresses a dibromochloropropane plume emanating from the rail classification yard. This document presents the results of the Soil Vapor Extraction (SVE) Pilot Study conducted between July and December, 1991 at the Motor Pool Area.

An Implementation Document was finalized in February, 1991 which outlined the pilot study plan for soil vapor extraction in the Motor Pool Area. The primary objective of this program was to collect data on the performance of SVE at this site. These data could be used to expand the soil vapor extraction system, if necessary. A secondary objective was to begin removing contaminants from the soil in the area. Section 2.0 of this report outlines the site history, a summary of previous investigations, and the nature and extent of contamination. Section 3.0 presents the technical approach to the pilot system design, including the data collection program and the rationale for evaluating system performance. Section 4.0 presents the test results of the pilot program including an analysis of the data. Section 5.0 presents the conclusions gathered from the pilot program. Appendix A presents the well construction details including soil boring logs and geologic cross sections. Appendix B presents raw analytical results from the SVE sampling program.

2.0
SITE BACKGROUND AND INTERIM ACTION INVESTIGATION

This section presents background information on the Motor Pool Area, including site history and the nature and extent of contamination based on previous field investigations. The October 1990 soil investigation and the scope and objectives of the pilot test are also discussed.

2.1 SITE DESCRIPTION

2.1.1 Location

Rocky Mountain Arsenal (RMA) occupies more than 17,000 acres (approximately 27 square miles) in Adams County, directly northeast of metropolitan Denver, Colorado (Figure 2-1). The Motor Pool Area consists of the developed area in the southeastern corner of Section 4 on the RMA. The Motor Pool Area is located near the rail yard, on the west side of the boundary line between Sections 3 and 4, and is approximately 650 feet (east-west) by 2,300 feet (north-south). Structures within the site include 7 above-ground fuel and oil storage tanks, 26 buildings and foundations for 3 buildings that have been removed. The structures consist of administration buildings, motor vehicle storage and maintenance buildings, warehouses, railroad roundhouse and tracks, former agricultural research buildings, fuel storage tanks, fuel station, and a groundwater well pumphouse (Figure 2-2).

2.1.2 History

Prior to 1942, the Motor Pool Area consisted of farm land that was used to produce wheat and corn, or was used as grass land for hay and grazing of cattle. The Motor Pool Area was acquired by the U.S. Army in 1942 as part of RMA. Railroad spurs into the study area, entering across the northwest and southern boundaries, were built during the initial construction of RMA (Ebasco 1989a).

Most of the structures in the study area were built by the Army during the initial construction period of 1942 to 1943. During this period, a sanitary sewer system was constructed that extended north from the Motor Pool and rail yard areas. Portions of the sewer ended in septic tanks and leach fields. In 1945, construction of the sewer was completed with the installation of two pump stations and a pressure pipe that discharged eastward to an outfall into the interceptor line north of the Administration area.

Since the 1940s, the Motor Pool Area has been used by RMA for servicing equipment, vehicles, and railroad cars, as well as for storing fuel, road oil, and flammable liquids.

The roundhouse (Building 631) has been in use since the beginning of operations at RMA in 1942. It has been used for the maintenance of locomotives, railcars, and other heavy equipment. Solvents used to clean parts and surfaces may have been discharged either to a ditch east of the roundhouse or to a septic tank. From 1968 to 1982, the building was used by the U.S. Army reserve units for vehicle maintenance. From 1975 to 1985, it was occasionally used as a repair shop for earth-moving equipment. A small structure for storing cleaning solvents and paint thinners, which were used in Building 631, is attached to Building 631.

Previous Motor Pool Area investigative studies include: a May 1984 Resource Conservation and Recovery Act (RCRA) audit by the Colorado Department of Health (Ebasco 1989a) in the area outside the roundhouse; a 1986 study to identify possible trichloroethylene (TCE) sources in the Motor Pool Area (Ebasco 1988); and a soil gas study conducted in February 1986 to aid in defining the presence of trichloroethylene in the groundwater (Ebasco 1987). The most recent studies include the Contamination Assessment Report (Ebasco 1988); the Western Study Area Report (Ebasco 1989a); a soil gas survey conducted in summer 1989 (WCC 1989), and a pre-design data collection program in October 1990 (WCC 1991a).

2.1.3 Site Geology

The Motor Pool Area is in Section 4 near the western boundary of the RMA. The ground surface in the study area is essentially flat with a nominal slope toward the northwest. There are two stratigraphic units of interest beneath the Motor Pool Area:

the Quaternary Alluvium and the Denver Formation. The alluvial material consists of discontinuous lenses of sand and gravel, interbedded with silt and clay. Gravels and gravelly sands are common at the base of the alluvial section, especially in paleochannels. The alluvial material ranges from about 70 feet to about 100 feet in thickness. Groundwater has been observed at between 60 and 70 feet below ground surface. The thickest alluvium occurs over bedrock lows, and the thinnest over bedrock highs.

The alluvium-bedrock contact is highly irregular due to the extensive erosion that was caused by ancient stream channels, which preceded the deposition of the alluvium. Generally, the bedrock surface slopes to the northwest in the Motor Pool Area; however, where the bedrock surface has been incised by an ancient stream channel, the slope becomes perpendicular to the trend of the paleochannel. A northwest trending paleochannel cuts across the northern boundary of the Motor Pool Area and has approximately 70 feet of relief.

The Denver Formation in the Motor Pool Area is predominantly composed of claystone with interbedded sandstone, siltstone, and lignite layers that vary from about 2 feet to approximately 20 feet thick. Layers of volcaniclastics are also present in the bedrock (Ebasco 1989a).

2.2 NATURE AND EXTENT OF CONTAMINATION

A summary of the nature and extent of contaminants found in the Motor Pool Area is discussed in this section. Information used in this summary was obtained from previous studies, including a soil gas investigation conducted in February 1986 to aid in defining trichloroethylene plumes in the groundwater (Ebasco 1987), a Contamination Assessment Report (Ebasco 1988), the Western Study Area Report (Ebasco 1989a), a soil gas survey conducted in summer 1989 (WCC 1990), and a pre-design data collection program in October 1990 (WCC 1991a). These reports can be referenced for additional details.

2.2.1 Soil Contamination

The soils investigations of the Motor Pool Area have been in three general areas:

- Repair, salvage, and surplus facility (Building 624) and railroad roundhouse (Building 631) areas
- Motor Pool and vehicle maintenance facility (Building 627) area
- Fuel tank storage area

The analytical data were derived from soil samples taken at various depths in the vadose zone. Sampling depths in the boreholes were generally 0 to 1, 4 to 5, 9 to 10, 14 to 15, and 19 to 20 feet. Borings greater than 20 feet in depth were sampled at 10-foot intervals below the 20 foot depth. A summary of the analytical results is shown in Table 2-1.

Indicator levels and ranges were established to assess the significance of organic and metal analytical values. Organic compound indicator levels are set at the certified reporting limit (CRL) for each compound. Metal indicator ranges are set within naturally occurring levels in the alluvial soils at RMA. These indicator ranges are shown in Table 2-1. A more detailed discussion of the selection of the indicator ranges can be found in the Introduction to the Contamination Assessment Reports (ESE 1987).

Trichloroethylene was detected in the area between the roundhouse (Building 631) and Building 624, in a near-surface soil sample taken beneath a man-made drainage ditch. This suggests that, at some time in the past, chlorinated solvents used at these facilities were present in the north-trending ditch.

Concentrations of ICP metals (cadmium, chromium, copper, lead, and zinc) and arsenic above background levels were also found in near-surface soil samples taken from beneath the ditch. This is attributed to the sanding and paint stripping operations performed during equipment maintenance and repair (Final Contaminant Assessment Report, Ebasco, July 1988).

Methylene chloride, trichloropropene, and aldrin were present in soil samples taken near the roundhouse (Table 2-1).

At Building 627, tetrachloroethylene was detected between 18 and 30 feet below grade beneath the same north trending ditch that passes between Building 624 and the roundhouse. These detections may suggest infiltration from the upgradient discharges at the roundhouse and Building 624.

Dibromochloropropane, toluene, and benzothiazole were found in near-surface soil samples taken downgradient from a drainage pipe exiting the south side of Building 627. The drain pipe discharged hot water and detergent in the mid-1960s and diluted wastes from the wash bay since 1951 (Ebasco 1989a).

Methylnaphthalene, pyrene, and fluoranthene were detected in near-surface soil samples taken in the north trending ditch west of Buildings 624 and 627. These analytes are attributed to leaching from railroad ties that had been treated with wood preservatives (Ebasco 1989a).

The fuel tank storage area is located west of Building 627 and consists of seven above-ground tanks. Soil samples from the area showed the following analytes to be present in the near-surface soils (concentrations are summarized in Table 2-1):

- Methylcyclohexane
- Benzene
- Ethylbenzene
- m-Xylene
- Toluene
- Methylnaphthalene

Lead and zinc occurred in surface soils at concentrations slightly exceeding their indicator ranges.

2.2.2 Previous Soil Gas Surveys

Three soil gas investigations have been conducted in the Motor Pool Area to locate organic contaminants. The first soil gas program was conducted in early 1986 (Ebasco 1987) when groundwater sampling had initially detected trichloroethylene near the roundhouse and Building 624. The trichloroethylene soil gas data showed a trichloroethylene soil vapor plume extending northwest from the Motor Pool Area. Another 1986 soil gas program used static samplers over a 1-month period. This study confirmed previous study results (Ebasco 1987).

The most recent soil gas investigation of the Motor Pool Area was conducted in July 1989. Eighty soil gas samples and 6 soil samples were collected in the study area. Sampling depths were 5, 10, 15, and 20 feet below grade, with a standard sampling depth of 5 feet. Sampling results are shown in Figure 2-3.

The volatile organic compounds that were analyzed for at each of the sampling locations included:

- Trichloroethylene (TCE)
- Trans 1,2 Dichloroethylene
- Cis 1,2 Dichloroethylene
- 1,1 Dichloroethylene
- Benzene
- Toluene
- Ethyl benzene
- o, m, p-Xylene

Measured concentrations of TCE in soil gas ranged from the detection limit (0.01 μg/l) to about 600 μg/l, with concentrations of TCE typically greater than 200 μg/l in the soil gas between Buildings 624 and 625. Figures 2-3 and 2-4 show the results of the grid sampling conducted in 1989. Additional samples taken in the immediate vicinity of building 624 are presented in tabular form in the field investigation report (WCC 1989).

Evidence seems to indicate that the origin of this TCE contamination is a 3-inch diameter floor drain, shown on 1942 plumbing plans of Building 624, that leads to an outside ditch located between Buildings 624 and 625. TCE was used as a degreasing agent in Building 624.

2.2.3 Groundwater Contamination

Groundwater in the Motor Pool area is 60 to 65 feet below the ground surface (Ebasco 1989a). During the soil gas survey conducted in 1986 at the Motor Pool Area, high TCE concentrations were detected near Buildings 624 and 631 (Ebasco 1987). Groundwater samples from the nearby alluvial wells detected TCE. From these data, the trichloroethylene alluvial groundwater plume is interpreted to originate in the Motor Pool Area and extend to the north-northwest (Figure 2-5). None of the Denver Formation wells in the western study area detected TCE. This finding suggests that the plume is confined in the upper portion of the unconfined aquifer at this site. Refer to the Remedial Investigation Final Report (Ebasco 1989a) for a detailed discussion on the groundwater contamination originating from the Motor Pool Area.

2.3 OCTOBER 1990 SOIL INVESTIGATION

Previous soil investigations at the Motor Pool Area have detected TCE in the soil (Table 2-1). Soil gas surveys in the area have found TCE in soil gas (Figure 2-3). Groundwater investigations have consistently detected elevated levels of TCE in groundwater in the Motor Pool Area (Ebasco 1989a). However, those investigations did not provide the information necessary to design a soil vapor extraction system. Therefore, a focused soil investigation was performed at the Motor Pool Area in October 1990.

The objective of this study was to further characterize the lateral and vertical extent of volatile halogenated organics (VHOs) in soil immediately to the west of Buildings 624 and 625, for purposes of collecting baseline information for the SVE system evaluation. A total of five borings were drilled and sampled at five-foot intervals between ground surface and groundwater. The samples were analyzed for VHOs. The boring locations (Figure 2-6) were selected to characterize the apparent plume observed during the 1989 soil gas survey (Figure 2-4).

Carbon-tetrachloride (CCl_4) was the only target analyte detected in the soil samples collected. The sample taken from boring COEMPA0005 from the 18 to 19 foot interval indicated CCl_4 at a concentration of 0.592 $\mu g/g$. The duplicate sample collected from the 17 to 18 foot interval reported CCl_4 as less than (LT) the certified reporting limit indicating the possibility the detection of this compound was due to a lab contaminant. All other samples were reported as LT for all the VHO target analytes.

Two of the borings (COEMPA0001 and COEMPA0002) were completed as soil gas extraction wells (VES-1 and VES-2, respectively). Well construction details can be found in the Implementation Document. These wells were used to conduct an initial air permeability test to establish a relationship between soil gas flow rate and vacuum applied at the well heads. This information, along with the analytical data from the soil investigation, were used to design the pilot system.

2.4 SCOPE OF PILOT PROGRAM

The five-month pilot program described in Section 3.0 focused on applying Soil Vapor Extraction to a volume of soil which has been shown to contain elevated levels of TCE in the soil gas. The soil vapor extraction wells used for the pilot program (VES-3 and VES-4) are located near the northwest corner of Building 624, approximately corresponding to the highest concentrations of TCE in soil gas detected in the 1989 soil gas survey. The soil to be addressed during the pilot test extends from the surface to groundwater, approximately 63 feet below ground surface.

The pilot program collected engineering data to confirm estimates of flow rate for the extraction wells and the radius of influence from each well. Soil permeability data was obtained when extracting from both wells to confirm the preliminary results gathered in a previous one-day study. Results of soil gas analyses were used with these data to estimate the quantitative effectiveness of vapor extraction at varying depths at this site.

TABLE 2-1

SUMMARY OF SOIL SAMPLE ANALYTICAL RESULTS
MOTOR POOL AREA

Analytical Groups and Analytes Detected	Frequency of Detections[1]	Range (μg/g)	CRL Range (μg/g)$^{1/2}$	Indicator Range (μg/l)
Organochlorine Pesticides				
Aldrin	2/163	0.9-3	0.3	
Arsenic	16/152	2.6-27	2.5-5	CRL-10
Mercury	14/152	0.057-0.38	0.050-0.060	CRL-0.1
ICP Metals				
Cadmium	13/152	1.4-30	0.66-0.74	1-2
Chromium	62/152	6.5-490	5.2-6.5	25-40
Copper	100/152	5.7-220	4.7-4.9	20-35
Lead	37/152	9.8-2000	8.4-13	25-40
Zinc	146/152	11-2300	8.7-9.5	60-80
DBCP	1/177	0.01	0.0050	
Polynuclear Aromatic Hydrocarbons				
Fluoranthene*	5/163	1-30	0.3*	
Pyrene*	6/163	0.5-20	0.3*	
Methyl naphthalene*	8/163	4-200	0.3*	

TABLE 2-1
(Continued)

Analytical Groups and Analytes Detected	Frequency of Detections[1]	Range (ug/g)	CRL Range (ug/g)[/2]	Indicator Range (ug/l)
Volatile Halogenated Organics				
Tetrachloroethylene	3/135	0.4-1	0.3	
Trichloroethylene	1/135	2	0.3-0.5	
Trichloropropene*	1/135	0.2	0.3*	
Methylene Chloride	1/135	3	0.7-2	
Volatile Hydrocarbons				
4-Hydroxy-4-methyl-2-pentanone*	1/135	4	0.3*	
Methylcyclohexane*	2/135	2-10	0.3*	
Volatile Aromatic Organics				
Ethylbenzene	1/135	4	0.3-0.4	
m-Xylene	1/135	2	0.7-0.8	
Toluene	2/135	2-4	0.3	
Organosulfur Compounds				
Benzothiozole	1/163	0.3	0.3*	

TABLE 2-1
(Concluded)

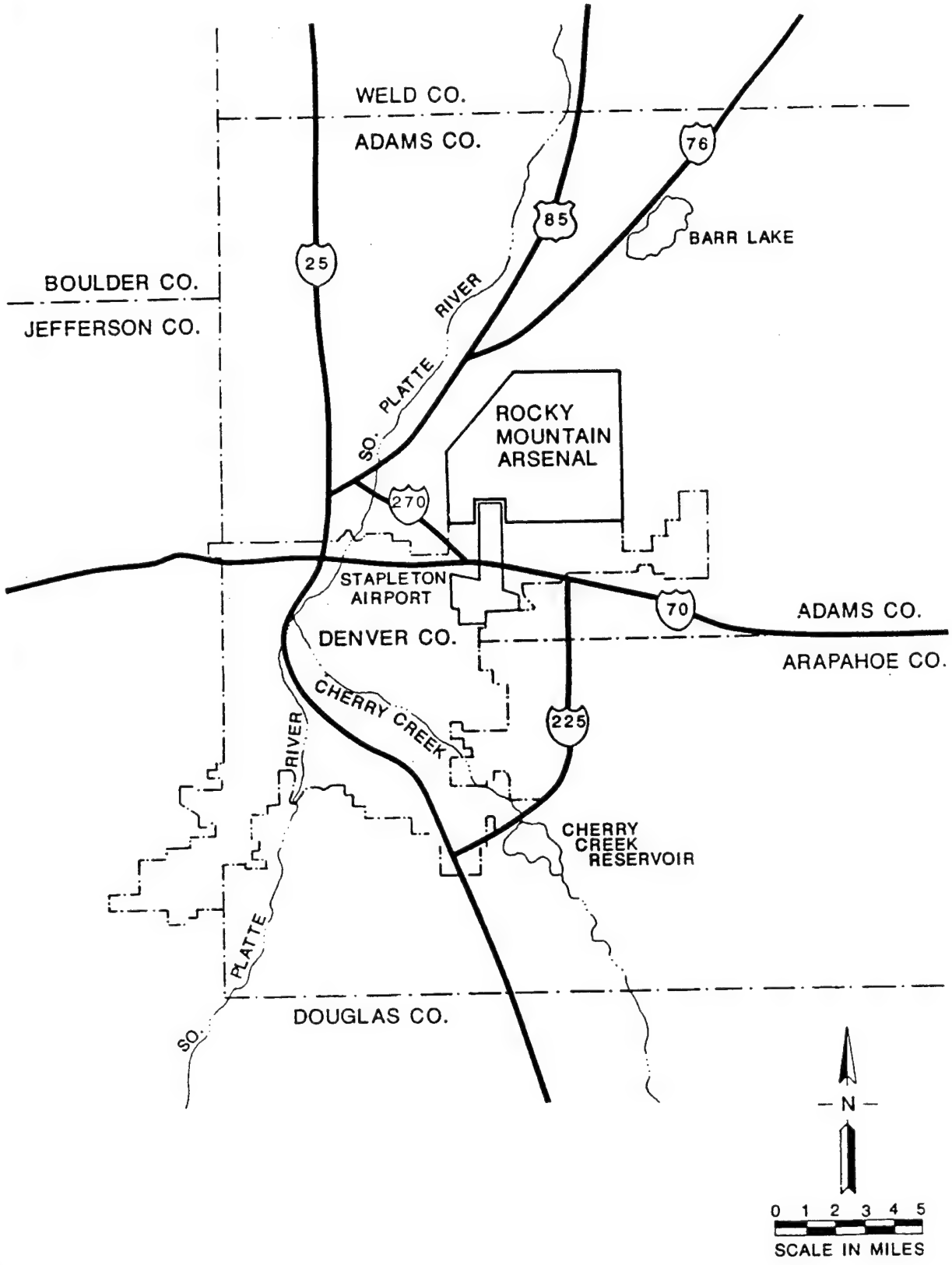
$\mu g/g$ - Micrograms per gram

[1] - Fraction represents the total number of samples with detections of an analyte in relation to the number of analyses conducted on all samples. This value does not include multiple detections of a specific analyte in the same sample, which occasionally has occurred when more than one analytical method has been used. Total number of borings, 36; total number of samples, 165.

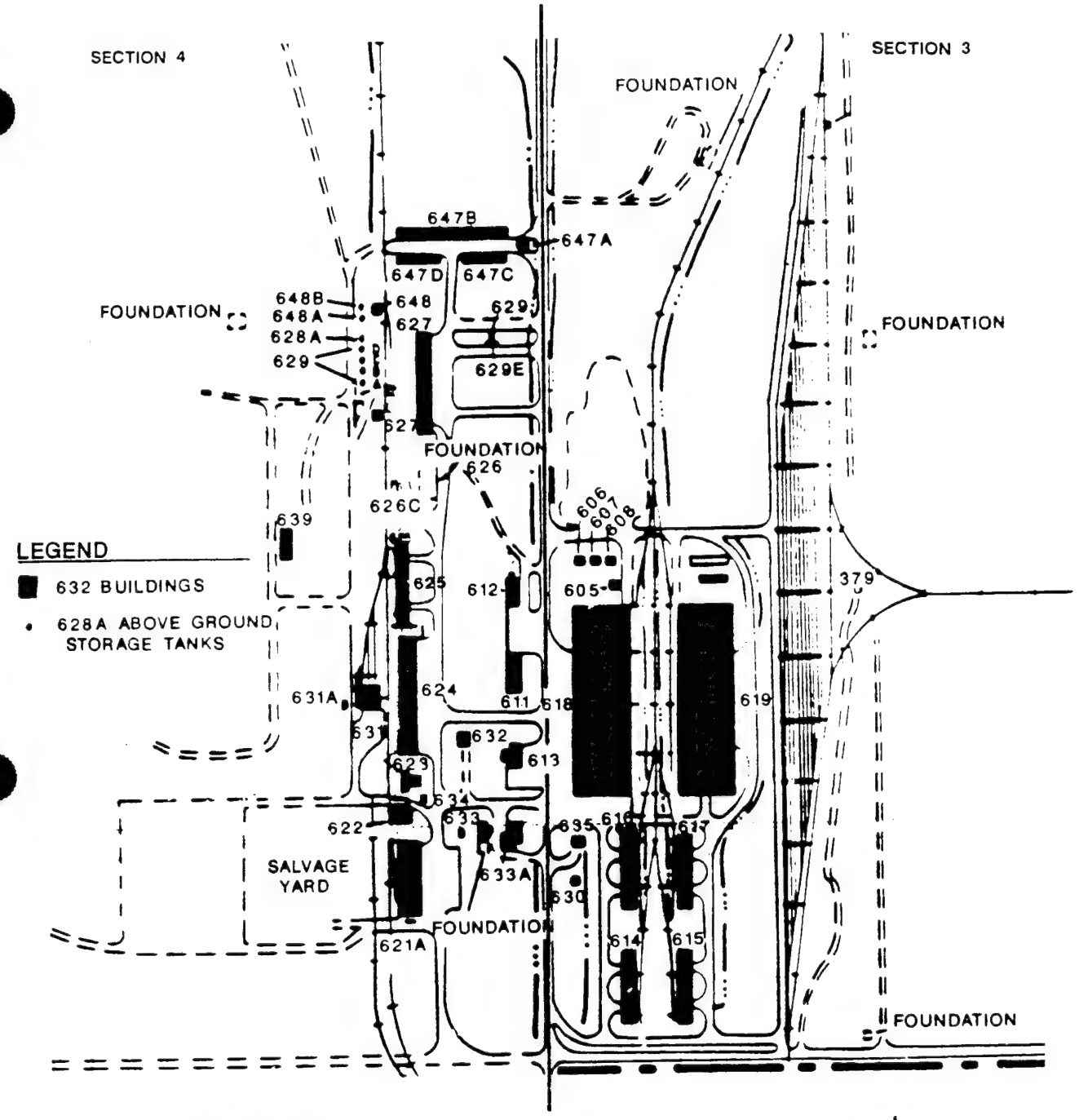
[2] - Certified Reporting Limit (CRL) or detection limit which varies among laboratories conducting analyses.

* - There is no CRL for tentatively identified compounds. The value shown is a detection unit based on 10% of the internal standard for the method used. The number of detections is given, but the number of samples is not.

SOURCE: Ebasco, May 1989



Job No. : 22765-4	ROCKY MOUNTAIN ARSENAL LOCATION MAP
Prepared by : R.E.S.	
Date : 3/26/92	**Figure 2-1**



KEY MAP, RMA

	23	24	19	20
27	26	25	30	29
33	34	35	36	31	32
4	3	2	1	6	5
9		11	12	7	8

MOTOR AREA POOL

RAIL CLASSIFICATION YARD

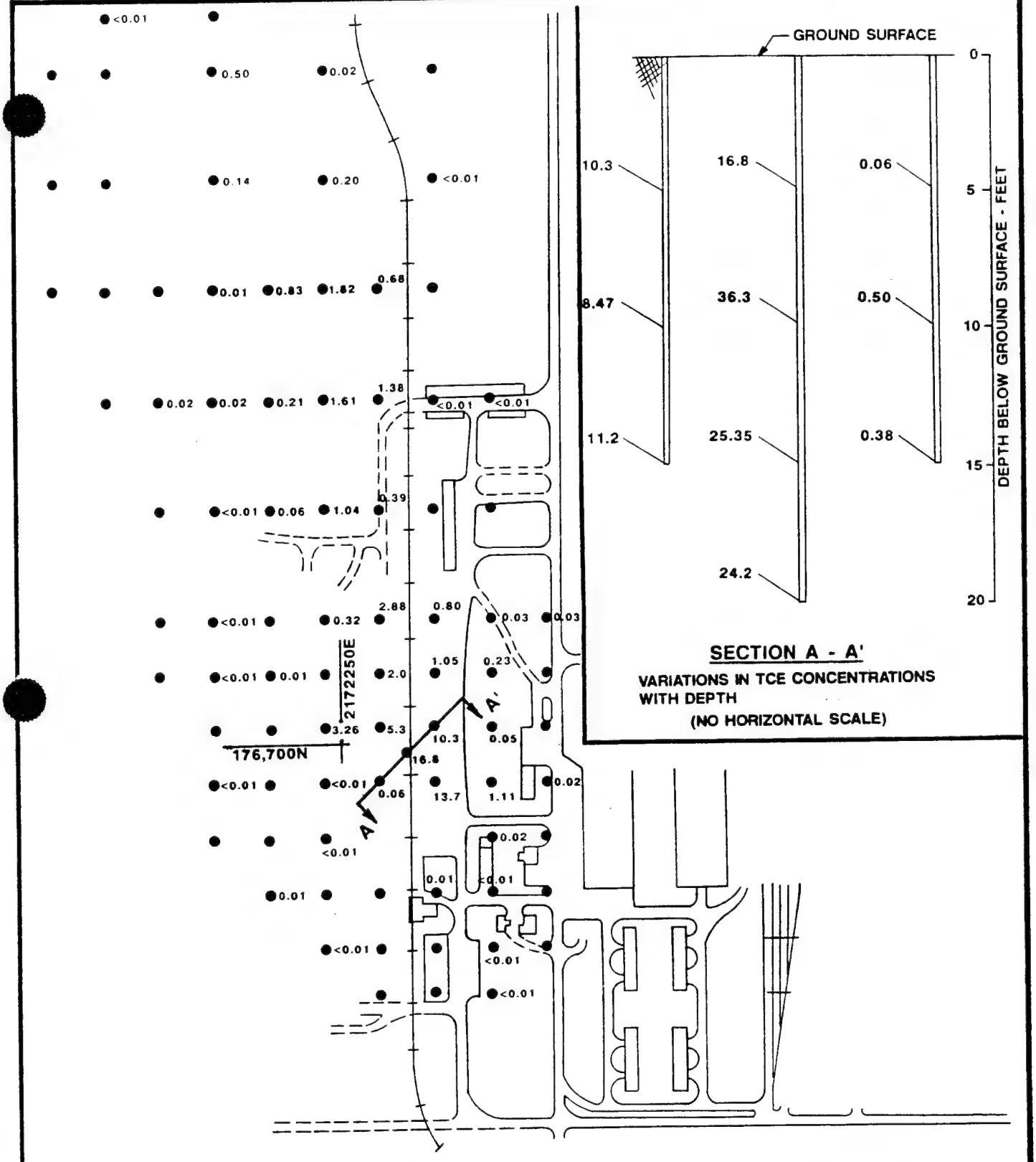
N

0 250 500 1000

SCALE IN FEET

SOURCE: EBASCO, MOTOR POOL AREA CONTAMINATION ASSESSMENT REPORT, 1988

Job No. : 22238-4400	MOTOR POOL AREA PILOT STUDY VICINITY MAP
Prepared by : K.A.S.	ROCKY MOUNTAIN ARSENAL, COLORADO
Date : 12/18/89	Figure 2-2



ALL TCE VALUES INDICATED IN PLAN ARE AT 5 FT. DEPTH.
VALUES ARE AS ug/l SOIL GAS

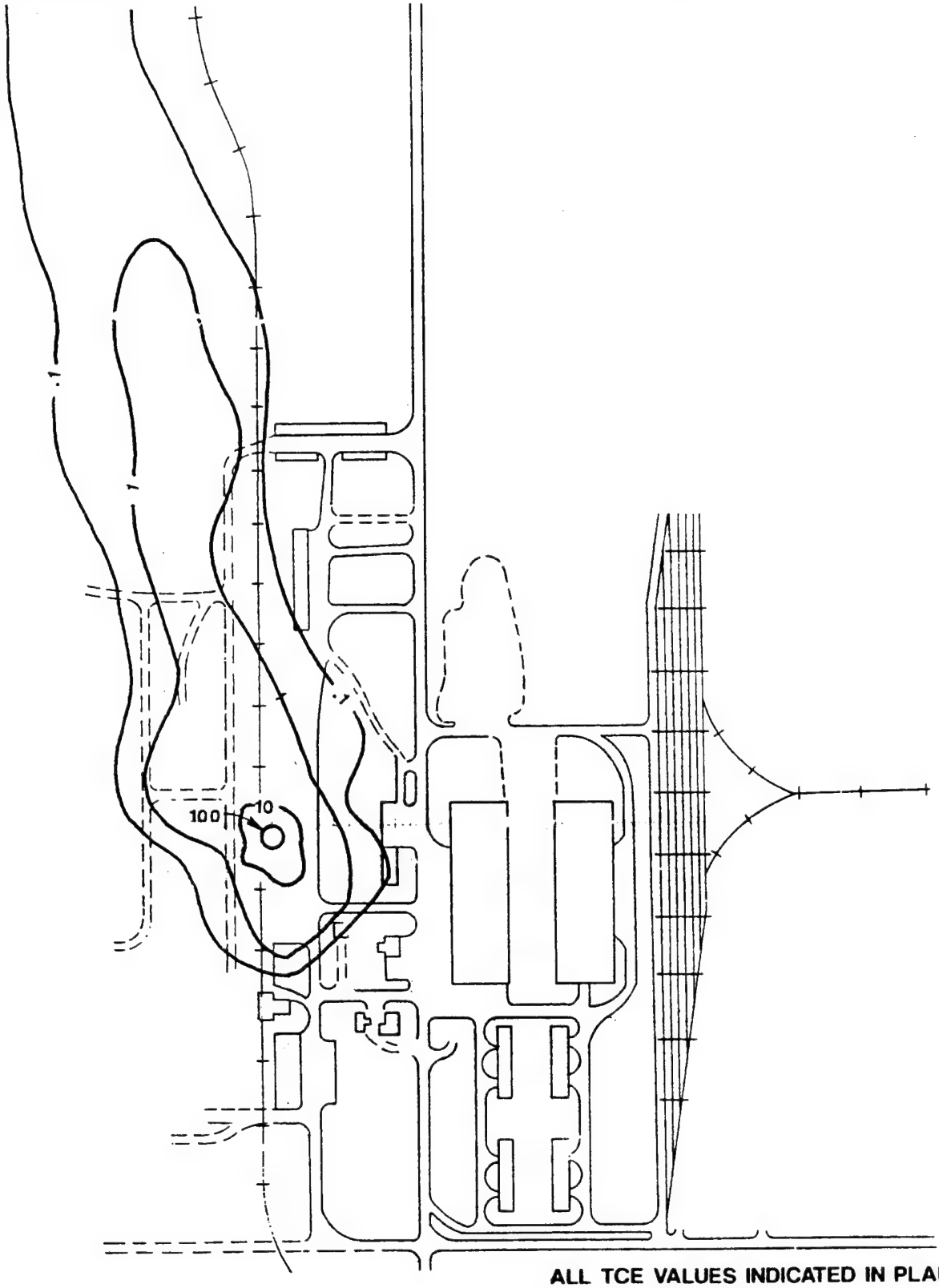
N

0 250 500 1000
SCALE IN FEET

Job No. :	89MC114G
Prepared by :	R.A.B
Date :	10/29/90

MOTOR POOL AREA PILOT STUDY
1989 TCE SOIL GAS SURVEY
ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 2-3



ALL TCE VALUES INDICATED IN PLAN ARE AT 5 FT. DEPTH.

LEGEND

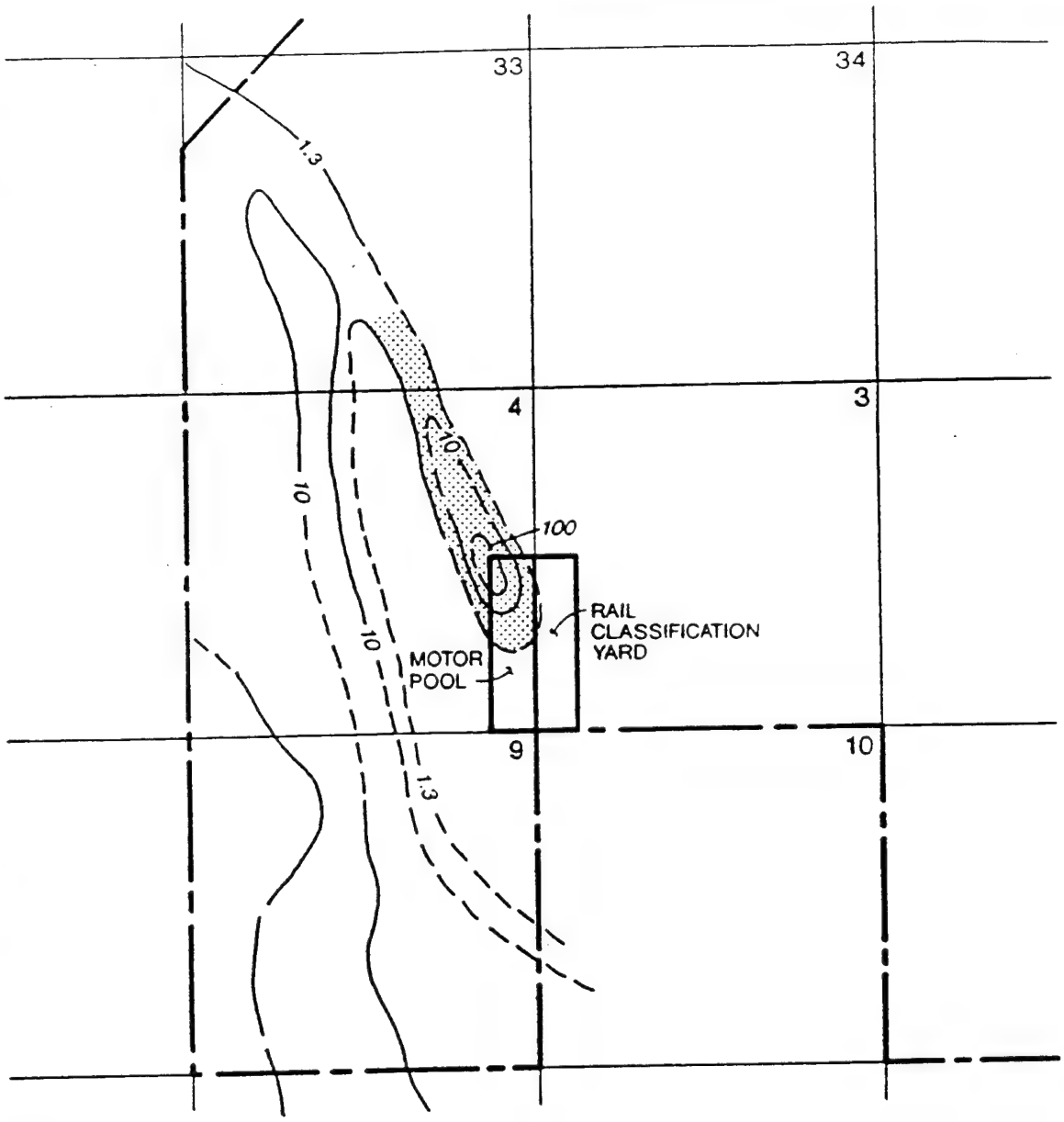
10 TCE in µg/l soil gas

N

0 250 500 1000

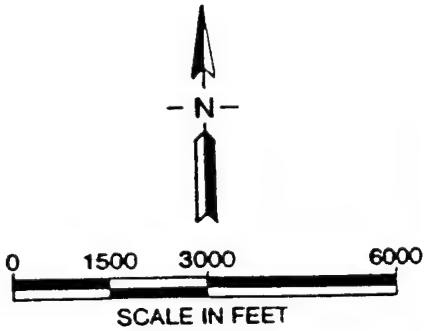
SCALE IN FEET

Job No. : 22238-4400	MOTOR POOL AREA PILOT STUDY 1989 SOIL GAS SURVEY ISO-CONCENTRATION PROFILE ROCKY MOUNTAIN ARSENAL, COLORADO
Prepared by : H.W.M./K.A.S.	
Date : 12/18/89	Figure 2-4



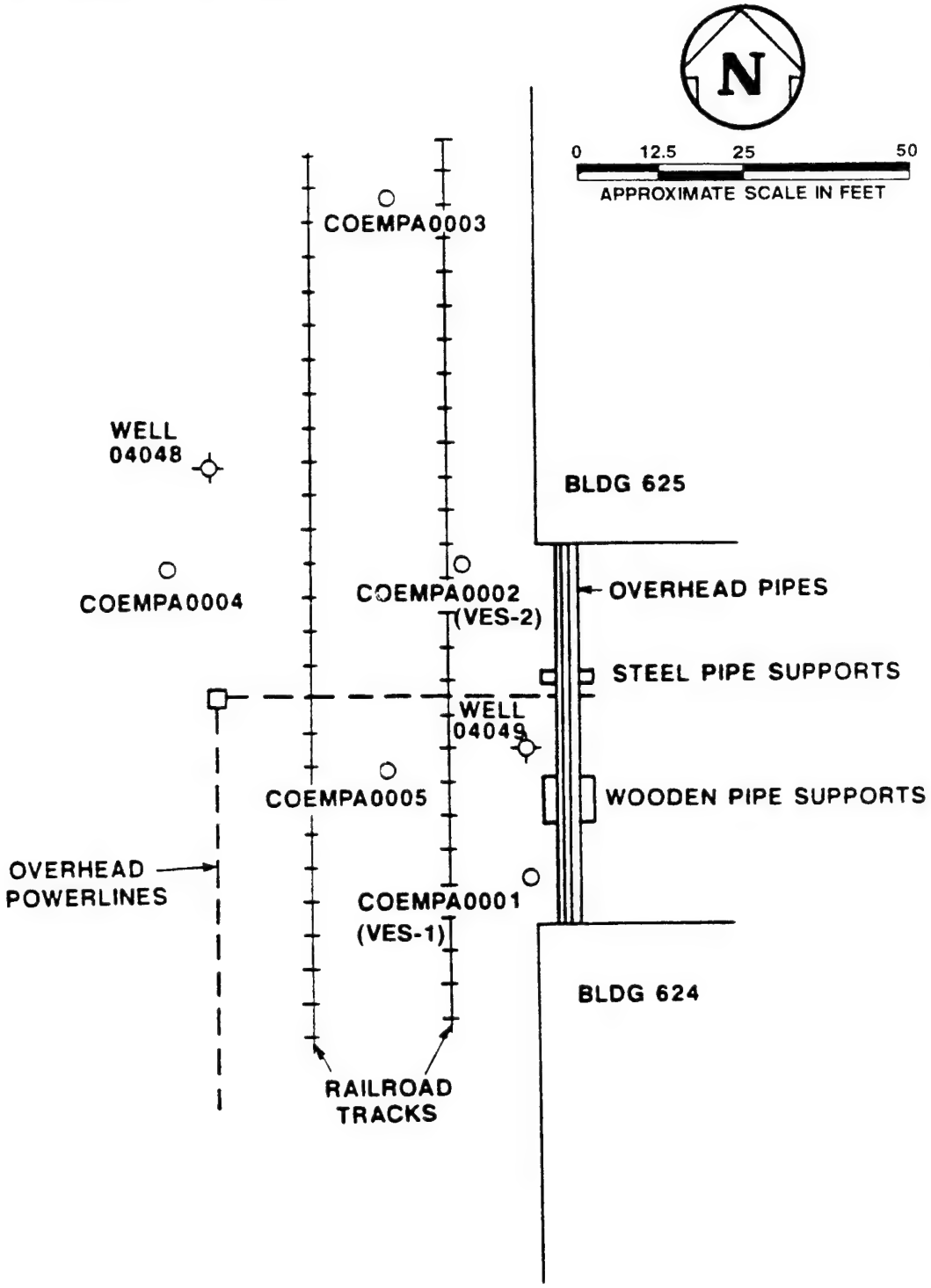
LEGEND

- Isoconcentration Line, Dashed where Inferred
- TCE Plume Emanating from the Motor Pool Area
- RMA Boundary
- Isoconcentration Values (ug/l)
  - *1.3*
  - *10*
  - *100*
  - *1000*
  - *2000*



SOURCE: Figure 4.3-19 Trichloroethene (TCE) Plumes/Unconfined Groundwater Flow System/Winter 1987/88 CMP Groundwater Monitoring Annual Report/Prepared by: R.L. Stollar & Associates Inc. Harding Lawson Associates

Job No. : **22765-4**	TCE GROUNDWATER PLUME
Prepared by : **R.E.S.**	
Date : **3/26/92**	**Figure 2-5**



LEGEND

○ BORING COEMPA00X

NOTE:
BORING COEMPA0001 AND BORING COEMPA0002 WERE COMPLETED AS SOIL VAPOR EXTRACTION WELLS (VES-1 AND VES-2, RESPECTIVELY)

Job No. : 89MC114G	MOTOR POOL AREA PRE-DESIGN STUDY BORING LOCATIONS
Prepared by : R.A.B.	ROCKY MOUNTAIN ARSENAL, COLORADO
Date : 10/9/90	FIGURE 2-6

3.0
TECHNICAL APPROACH

This section presents a description of the SVE system used for this pilot study and discusses details of the pilot test operation as well as the data collection and analysis program.

3.1 SYSTEM DESCRIPTION

In situ soil vapor extraction systems provide a method to remove volatile organic compounds (VOCs) from contaminated soil. When operated properly, an SVE system can be one of the most cost-effective remediation processes for soils contaminated with gasoline, solvents, or other volatile compounds. When an SVE system is applicable, partial or complete remediation is possible using simple equipment, with minimal requirements for intrusive procedures such as excavation, and with little or no contaminated materials requiring disposal.

An SVE system, in its simplest form, consists of one or more extraction wells, a separation tank to remove entrained or condensed water, and a vacuum blower to draw vapors containing the volatile contaminants from the soil. Often, the extracted vapors may be discharged directly to the atmosphere. In some cases, because of regulatory requirements or health risks, above-ground treatment of the extracted vapors may be required. Treatment technologies commonly employed include adsorption of the vapor phase organic compounds on granular activated carbon (GAC) or thermal/catalytic treatment of the organic vapors.

3.1.1 Extraction and Monitoring Wells

As shown in Figure 3-1, two soil borings were completed as extraction wells (VES-1 and VES-2) during the 1990 soil sampling event. A one-day study was performed using these wells and a mobile SVE system to gather preliminary data to aid in the design of the pilot system. Based on the air permeability data obtained during this study, extraction wells VES-3 and VES-4 were installed for the pilot test. VES-3 was screened from

approximately 13 to 28 below ground surface (bgs) and was used for testing the shallow extraction zone. VES-4 was screened from approximately 43 to 58 feet bgs for testing a deeper screened interval. The purpose of extracting from both a deep and shallow zone was to assess the optimal screened interval for future vapor extraction wells in the event that the pilot test results indicated that additional vapor extraction wells were appropriate. The SVE system designed for this pilot study can be easily scaled up to accommodate additional extraction wells.

Based on the suspected plume gradient, four clusters of soil gas monitoring wells were installed at the locations shown in Figure 3-1. Each cluster had a well screened in the following locations: a shallow interval, (A), within the range of approximately 12 to 14 feet bgs, to evaluate whether any significant short-circuiting occurred as a result of air being drawn in from the ground surface; an intermediate interval, (B), within the clay layer to evaluate the effect of the SVE system on soil gas within the low permeability lens (30 to 38 feet bgs); and a deep interval, (C), within the range of approximately 52 to 56 feet bgs and near the groundwater table, to evaluate temporal trends of soil gas concentrations near the groundwater. Soil gas monitoring wells P-5, P-6, and P-7 extended radially to the north of the extraction wells, while P-8 was located to the west of the wells to evaluate radial variations.

The soil gas monitoring probes consisted of a 1-foot long, 1-inch-diameter slotted (.02-inch slots) PVC pipe with caps on both ends. During installation, the soil gas monitoring probes were lowered into the 4-inch diameter borings to the previously specified depth. A coarse sand was backfilled around the probes. Each probe was connected to the surface with ¼-inch diameter polyethylene tubing for monitoring the vacuum and TCE concentrations in the soil gas.

3.1.2 Above-Ground Equipment

The shallow and deep extraction wells were connected to the vacuum blower through an insulated PVC pipe installed on the ground surface. The blower and associated equipment were located in a temporary building near the northwest corner of Building 624. A liquid/vapor separator tank was installed between the extraction wells and the blower to allow for collection of any moisture that condensed from the gas stream. The

separation tank was equipped with an automatic vacuum relief valve, a vacuum gauge, a site gauge (to monitor the amount of water in the tank), a drain valve, and a liquid level float-operated switch to shut the system down, should the water level rise past a preset level. (No water was collected during the operation of this pilot unit.) An inline filter was installed prior to the blower to remove any fines or silts which could damage the blower impeller. A regenerative blower driven by a 10-hp electric motor, capable of moving 250 cubic feet per minute (cfm) at 30 inches of water (vacuum) was selected for this pilot system. This belt-driven blower had the capability of operating under a wide range of conditions. To remove TCE from the extracted gas, the exhaust air was discharged to a series of GAC canisters. The first series of vapor phase GAC canisters was capable of removing approximately 90 percent of the TCE from the extracted gas, while the second series of canisters served as polishing units. Refer to Figure 3-2, Process Flow Diagram, for locations of the monitoring instrumentation and sampling ports.

3.2 PILOT TEST OPERATION AND DATA COLLECTION PROGRAM

The Rocky Mountain Arsenal Motor Pool Area pilot test consisted of two sequential phases: short-term operation and long-term operation. Data was collected during these two phases of operation to provide information to meet the following objectives:

- Evaluate the horizontal and vertical soil gas VOC distribution at the Motor Pool Area to attempt to identify the nature or source of TCE.

- Evaluate the effectiveness of soil vapor extraction at the site.

- Evaluate the optimal extraction interval and operating conditions, based on observed pressure distributions, flow rates, and soil gas VOC distributions.

3.2.1 Short-Term Operation

The short-term operation period was conducted during the first four weeks of the pilot test where soil gas was extracted from VES-3 (shallow) for two weeks and then from

VES-4 (deep) for the two remaining weeks. Field sampling and analysis was performed on the first, third, and fifth days of both weeks, and laboratory analysis was performed on the first, third, and fifth days of the first week and in the middle of the second week. This program was repeated during weeks 3 and 4 when soil gas was extracted from the deep interval.

3.2.2 Long-Term Operation

The long-term operation began immediately following the short-term operation period and continued for approximately four additional months. Soil gas was extracted from the shallow interval during the first part of the long-term operation. Soil gas extraction continued at a steady state for approximately two weeks. System operation was then suspended for one week. This cycle was repeated three times while extracting soil gas from the shallow unit. Soil gas was then extracted from the deep interval, and the same cycle (steady state, recovery) was repeated three times.

3.2.3 Data Collection

The data collected from the short-term operation is summarized in Table 3-1, and the data collected from the long-term operation is summarized in Table 3-2. Field data collection included recording of barometric pressure; pressure readings at the extraction well (VES-3 or VES-4), separation tank, before the first GAC unit, between the two GAC units, after the second GAC unit, and at all three depths of each of the four soil gas monitoring wells; temperature readings before and after the GAC units; and flow rate of the extracted gas from the orifice meter. These data were used to evaluate operating parameters for remediation.

Field sampling and analysis was performed using TCE-specific Sensidyne tubes and/or a photoionization detector (HNu) at the following 15 points: gas extracted from either VES-3 or VES-4; gas between the two GAC units; gas after the second GAC unit; at all three depths for each of the four soil gas monitoring wells.

Confirmation sampling and analysis consisted of taking samples and sending the samples to a laboratory for chemical analysis. A modified NIOSH method using a Gilian®

personal sampling pump and charcoal tube samples was used for the confirmation sampling and analysis. Confirmation sampling and analysis was done at the following 14 points: gas extracted from either VES-3 or VES-4; gas after the second GAC unit; at all three depths of each of the four soil gas monitoring wells.

The long-term operation consisted of the six cycles as described above, with three cycles for shallow extraction and three cycles for deep extraction. Each cycle consisted of an initial sampling round followed by approximately two weeks of steady state operation and one week of suspended operation. Field data, field samples, and lab samples were collected at the beginning of each cycle. During steady state operations, field data were collected three times each week, field samples at the beginning and end of the week, and a lab sample was taken from the extraction well at the end of the week. At the end of the third cycle, the initial sampling set was performed at the end of the week of suspended operations, before the program was repeated in the deep interval.

Data were analyzed to evaluate the potential source(s) of the soil gas VOC concentrations, and to identify operating parameters for the SVE system during this program. Vacuum distribution was evaluated to determine flow patterns and chemical analysis was evaluated to estimate system performance. Analytical chemistry results can be found in Appendix B.

TABLE 3-1

SHORT-TERM OPERATION MONITORING PROGRAM
MOTOR POOL SVE PILOT TEST

	Field Data Collection[1]		Field Sampling & Analysis[2] (15 Sampling Points)			Laboratory Analysis[3] (14 Sampling Points)		
Period of Operation	Frequency	No. of Sampling Events	Frequency	No. of Sampling Events	Total Number of Samples	Frequency	No. of Sampling Events	Total Number of Samples[4]
Short-term Operation - Shallow Extraction (VES-3)								
First Week	Daily	5	First, third, and fifth day	3	45	First, third, and fifth day	3	51
Second Week	Daily	5	First, third, and fifth day	3	45	Once (mid-week)	1	17
Short-term Operation - Deep Extraction (VES-4)								
Third Week	Daily	5	First, third, and fifth day	3	45	First, third, and fifth day	3	51
Fourth Week	Daily	5	First, third, and fifth day	3	45	Once (mid-week)	1	17
Total				12	180		8	136

TABLE 3-1
(Concluded)

---

[1] Field data collection includes recording of: pressure readings at the extraction well (VES-3 or VES-4), separation tank, before the first GAC unit, between GAC units, after the second GAC unit, and at each of the three intervals (shallow, medium, and deep) of each of the four monitoring wells; temperature readings before and after the GAC units; flow rate of extracted gas from the orifice meter; and field conditions (temperature, weather conditions, barometric pressure).

[2] Field sampling and analysis involves the use of TCE-specific draeger tubes (or equivalent) and/or a photoionization detector at 15 sampling points: the extraction well (VES-3 or VES-4); gas between the GAC units; gas after the second GAC unit; and gas from each of the three intervals (shallow, medium, and deep) of each of the four monitoring wells.

[3] Samples from 14 sampling points will be analyzed for VOC concentrations: the extraction well (VES-3 or VES-4); gas after the two GAC units; and gas from each of the three intervals (shallow, medium, and deep) of each of the four monitoring wells.

[4] Total number of samples includes a duplicate, field blank, and trip blank (QA/QC samples) for each sampling event (i.e., total number of samples = no. of sampling events x (14 sampling points + 3 QA/QC samples).

TABLE 3-2

LONG-TERM OPERATION MONITORING PROGRAM
MOTOR POOL SVE PILOT TEST

	Field Data Collection[1]		Field Sampling & Analysis[2] (15 Sampling Points)				
Period of Cycle	Frequency	No. of Sampling Events	Frequency (per cycle)	No. of Sampling Events (per cycle)	Frequency (for 3 cycles)	Total Number of Sampling Events (for 3 cycles)	Total No. of Samples
Initial Sample	Once	1	Once	1	1	1	15
Steady State	Three times per week	6	At beginning and end of each week	4	3	12	180
Recovery	Three times per week	3	Once	1	3	3	45
Total for Three Cycles (shallow well)						16	240
Total for Long-term Operation (shallow and deep well)						32	480

TABLE 3-2
(Concluded)

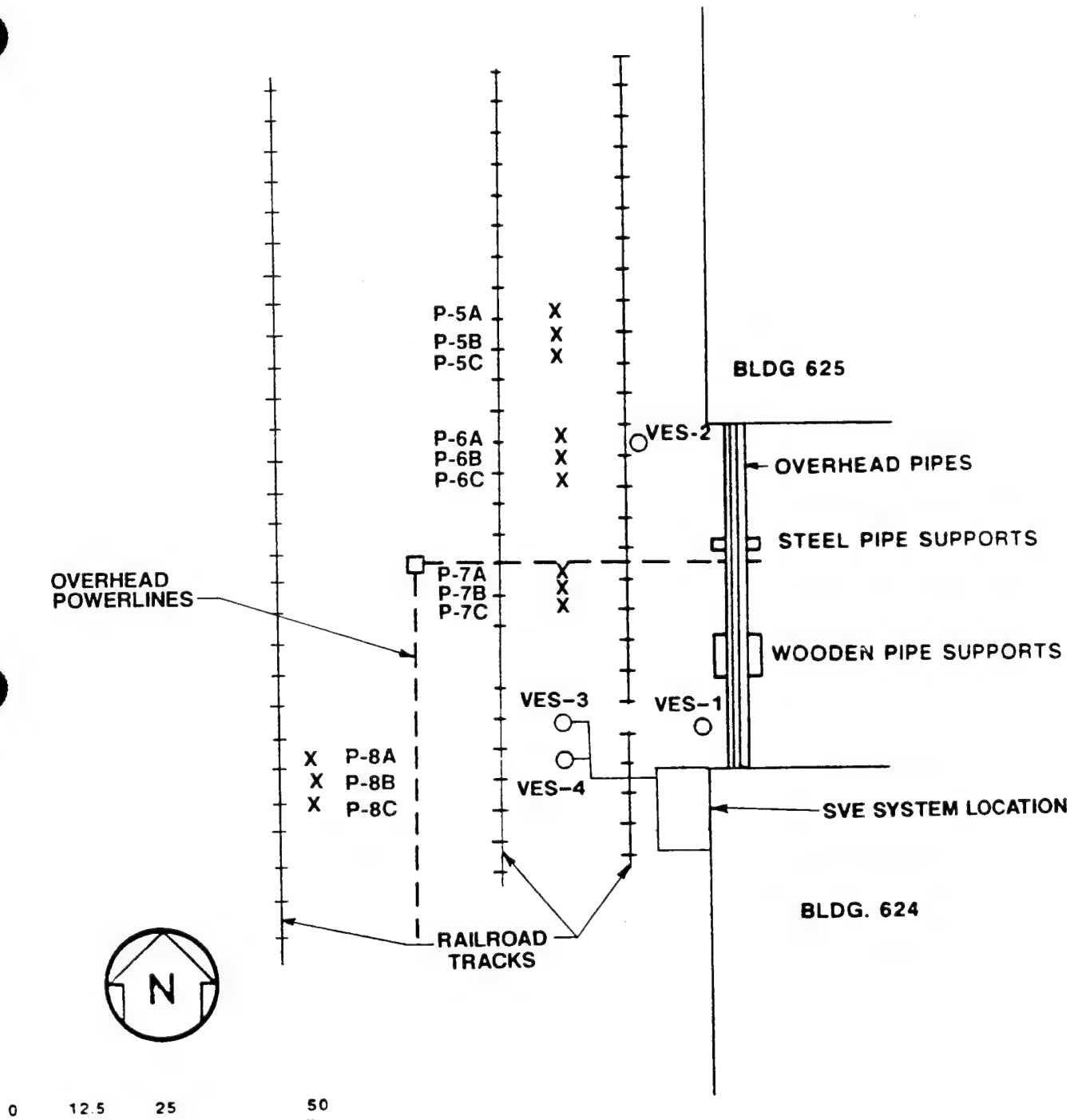
Period of Cycle	Laboratory Analysis[3]					
	Frequency (per cycle)	No. of Sampling Events (per cycle)	Frequency (for 3 cycles)	Total No. of Sampling Events (for 3 cycles)	No. of Sampling Points	Total Number of Samples[4]
Initial Sample	Once	1	1	1	14	17
Steady State	At end of week	2	3	6	1	24
Recovery	Once	1	3	3	14	51
Total for Three Cycles (shallow well)				10		92
Total for Long-Term Operation (shallow and deep well)				20		184

[1] Field data collection includes recording of: pressure readings at the extraction well (VES-3 or VES-4), separation tank, before the first GAC unit, between GAC units, after the second GAC unit, and at each of the three intervals of each of the four monitoring wells; temperature readings before and after the GAC units; flow rate of extracted gas from the orifice meter; and field conditions (temperature, weather conditions, barometric pressure).

[2] Field sampling and analysis involves the use of TCE-specific Draeger tubes (or equivalent) and/or photoionization detector at 15 sampling points: the extraction well (VES-3 or VES-4); gas between the GAC units; gas after the second GAC unit; and gas from each of the three intervals of each of the four monitoring wells.

[3] Samples from 14 sampling points will be analyzed for VOC concentrations: the extraction well (VES-3 or VES-4); gas after the two GAC units; and gas from each of the three intervals of each of the four monitoring wells. When only one sampling point is specified, that point is the extraction well (VES-3 or VES-4).

[4] Total number of samples includes a duplicate, field blank, and trip blank (QA/QC samples) for each sampling event (i.e., total number of samples = total no. of sampling events x (14 sampling points + 3 QA/QC samples))

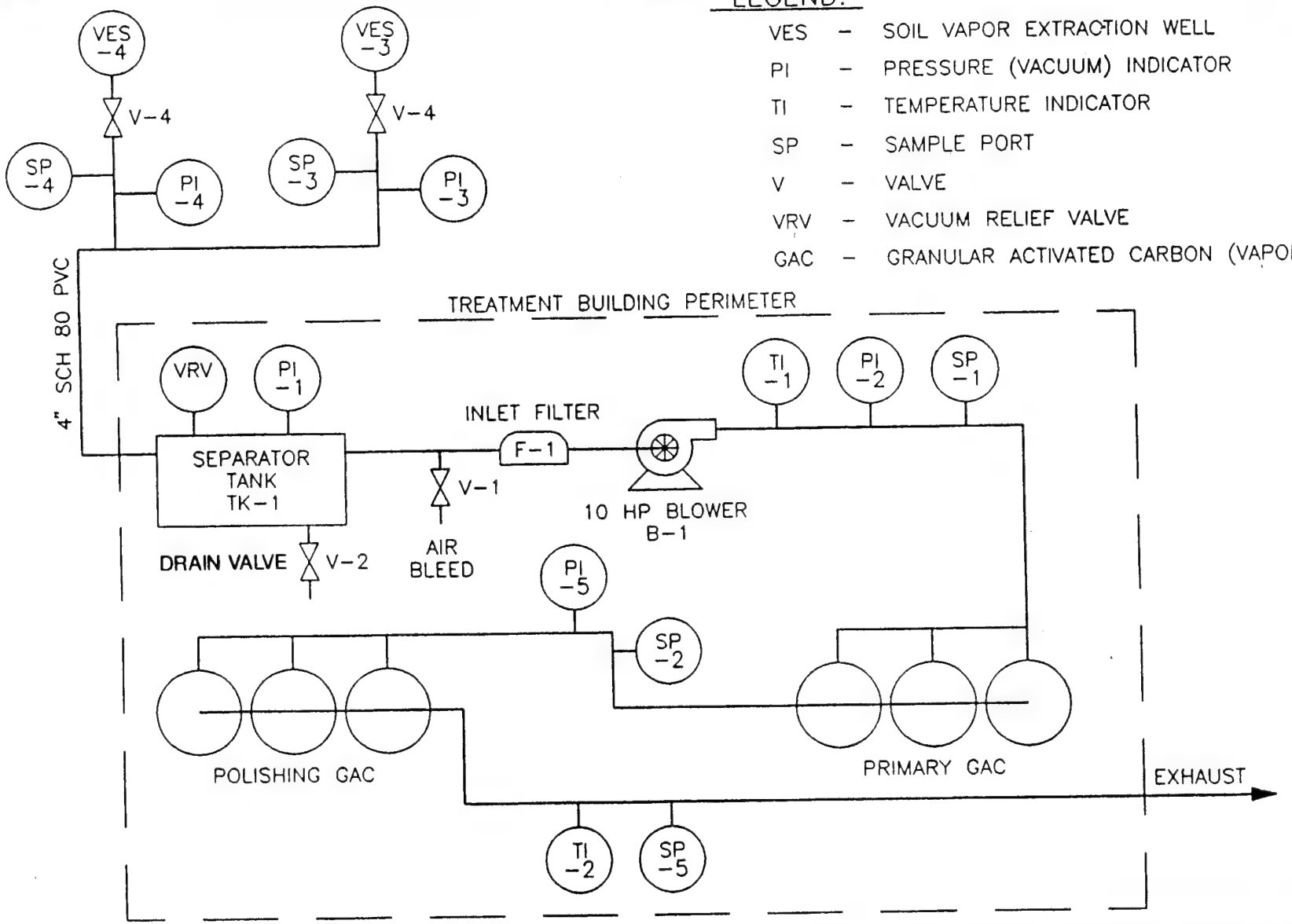


LEGEND

VES-1 ○ SOIL VAPOR EXTRACTION WELL

P-5A X SOIL GAS MONITORING WELL

Job No. : 89MC114G1	MOTOR POOL AREA PILOT STUDY SVE WELL LOCATIONS
Prepared by : R.E.S.	ROCKY MOUNTAIN ARSENAL, COLORADO
Date : 12/10/91	Figure 3-1



Job No. : 89MC114G1	SOIL VAPOR EXTRACTION SYSTEM PROCESS FLOW DIAGRAM MOTOR POOL AREA PILOT STUDY
Prepared by : RES	
Date : 12/10/91	**Figure 3-2**

4.0
OBSERVATIONS AND RESULTS

4.1 AIR PERMEABILITY TEST RESULTS

Prior to initiation of the data collection program, the soil permeability to air flow (a measure of the ability of air to pass through a porous media) was estimated to confirm the suitability of soil vapor extraction for this site. To calculate soil permeability, vacuum readings were taken at P-7B (representative of medium depth soil gas monitoring wells) at 5-minute intervals during system start-up. These readings were taken until steady state conditions were observed (approximately 30 minutes). Figure 4-1 shows a plot of vacuum at P-7B vs. the natural log of time when extracting from the shallow extraction well. This figure was used to predict the soil permeability to vapor flow in soils from the ground surface to approximately 38 feet bgs. The slope and Y-intercept of this plot were used in the following equation (Johnson et al., 1990) to predict soil permeability:

$$K = \frac{r^2 \, \epsilon \mu}{4 \, P_{atm}} \exp\left(\frac{B}{A} + 0.5772\right)$$

where:

r	=	radial distance from vapor extraction well, 22 feet
ϵ	=	air-filled soil void fraction, 0.3
μ	=	viscosity of air, 1.8×10^{-4} g/cm-s
K	=	soil permeability to air flow (Darcys, or cm^2)
P_{atm}	=	ambient atmospheric pressure, 0.83 atm
B	=	Y-intercept from plot of pressure vs. natural log of time
A	=	slope from plot of pressure vs. natural log of time

This equation predicts a soil permeability to air flow of 167 darcys, indicative of silty to clean sand (Freeze and Cherry, 1979). The soil permeability to air flow was also estimated for extraction of soil gas from the deep extraction well (VES-4). Vacuum readings were taken at P-5C (62.5 feet radially from the extraction well) at 5-minute

intervals until steady state conditions were observed. Using Figure 4-2 and the same correlation, soil permeability to air flow was estimated at 2860 darcys. The higher permeability in the deeper region is indicative of clean sand to gravel. The high soil permeability-to-vapor flow, in both the shallow and deep regions, confirmed the suitability of soil vapor extraction to remediate contaminated soils at the RMA MPA.

4.2 SHORT-TERM OPERATION

The short-term operation of the pilot study was completed August 9, 1991. Figure 4-3 shows the TCE concentration in the blower exhaust decreasing from 51.6 mg/l or parts per million (ppm) to 10.6 ppm after the first week of extraction from the shallow well, VES-3. Figure 4-4 shows the TCE concentration in the blower exhaust decreasing from 18.3 ppm to 5.8 ppm during a 10-day period of extraction from the deep well VES-4. Comparing Figures 4-3 and 4-4, it can be seen that the initial TCE concentration detected in the blower exhaust was greater during the shallow well extraction. It may have been that the majority of the remaining TCE in the vadose zone is present above the clay lens. This suggests that the contribution from TCE re-volatilizing from the groundwater is probably minimal.

4.3 LONG-TERM OPERATION

Figures 4-5 and 4-6 show the TCE concentration measured at the blower exhaust during the long-term operation for both the shallow and deep extraction wells. The exhaust concentrations ranged from 2,500 parts per billion (ppb) to 4,300 ppb in the shallow extraction well and 2,400 ppb to 2,800 ppb in the deep extraction well. This was considerably less than observed during the short-term operation, indicating that the majority of TCE contamination had been removed during the initial operation of the pilot study. As expected, the TCE concentration continued to decrease until the system was shut down for the designated recovery period. The TCE exhaust concentration increased slightly when system operation was initiated after the recovery period. For example, in the shallow well, the TCE concentration increased from approximately 2,500 ppb to 3,800 ppb during an initial recovery period. The results of the intermittent flow or pulsing operations suggest that the volatilization of TCE was somewhat limited

by either diffusion of the adsorbed TCE on the soil or the dissolved TCE in the groundwater to the induced air stream.

Table 4-1 presents the overall results of the pilot study for both short and long-term operation including TCE concentrations in the soil gas monitoring wells. The concentration of TCE measured at the blower exhaust during the entire pilot study is shown graphically in Figure 4-7. As seen in this figure, the exhaust concentration decreased rapidly during the short-term operation but remained low and relatively consistent throughout the remainder of the study.

4.4 SYSTEM EFFECTIVENESS

Figures 4-8 and 4-9 represent the vacuum measured at the monitoring wells as a function of their distance from the extraction well. The nearest monitoring wells are P-7 A, B, and C, at a distance of approximately 22 feet. The farthest wells are P-5 A, B, and C, at 62.5 feet. Figure 4-8 represents vacuum decreases with respect to distance, as measured in the shallow soil gas monitoring wells when extracting from the shallow interval. As expected, the vacuum in the shallow soil gas monitoring wells decreased as the distance from the shallow extraction well increased. Appreciable vacuum (0.6 inches of water column) was still being measured 62.5 feet from the extraction well at monitoring well P-5A indicating the lack of a surface seal did not significantly reduce the radial influence of the shallow extraction well. The vacuum at the medium and deep soil gas monitoring wells, although considerably less than in the shallow zone, remained relatively constant, independent of distance from the extraction well. It appears the clay lens prevented the shallow extraction well from effectively influencing the deeper regions.

Figure 4-9 shows the vacuum distribution during deep well extraction. The small and relatively constant vacuum measured in the shallow soil gas monitoring wells (12 to 14 feet bgs) indicates that the clay is apparently providing an effective boundary to soil gas flow. As predicted, the vacuum decreased with distance from the deep extraction well in the medium and deep soil gas monitoring wells.

The concentration of TCE in each of the soil gas monitoring wells had decreased to non-detectable or low levels during the course of the pilot study. Figures 4-10 through 4-13 depict the rapid decrease in soil gas concentrations in the shallow monitoring wells after completion of the short-term operation. In the shallow monitoring wells, intermittent flow operation did not result in an expected rebound in soil gas concentrations in the later recovery periods, indicating that the shallow region had been completely remediated with extraction from the shallow well. Figures 4-14 through 4-17 and Figures 4-18 through 4-21 show TCE concentrations over time in medium and deep regions of the monitoring wells, respectively. As with the shallow region, the TCE concentrations in the medium and deep regions decreased dramatically during the short-term operation. As shown in these figures, the initial recovery phases during the long-term operation did result in corresponding small increases in TCE concentrations as measured in the soil gas monitoring wells. The later recovery phases produced no significant increase in TCE concentrations.

Table 4-2 presents a summary of the typical operating conditions recorded during the SVE pilot study.

Figure 4-22 shows a plot of the total mass TCE extracted over the pilot study, with approximately 67 lbs removed in approximately five months of system operation. Although 1,2-dichloroethene and vinyl chloride were analyzed for during the test, neither analyte was observed in any of the samples.

TABLE 4-1

SVE PILOT STUDY
SUMMARY OF ANALYTICAL RESULTS

Sampling Date	TCE Concentrations (ppm)													
	P-5A	P-5B	P-5C	P-6A	P-6B	P-6C	P-7A	P-7B	P-7C	P-8A	P-8B	P-8C	VES-3	VES-4
STS														
7-16-91	12.9	30.2	34.2	27.8	36.8	34.1	65.4	44.4	36.3	15.5	19.4	4.3		
7-17-91	23.5	6.3	ND	12.2	6.5	ND	7.6	10.8	ND	2.1	2.2	0.9	51.6	
7-19-91	5.3	20.0	23.4	6.5	20.1	26.5	ND	24.6	25.7	ND	11.6	11.9	16.7	
7-24-91	1.0	3.1	7.5	3.1	7.3	20.2	ND	14.4	8.3	ND	4.2	ND	10.6	
STD														
7-29-91	ND	2.1	ND	1.1	3.1	2.1	ND	3.1	2.1	ND	3.2	ND		18.3
7-31-91	ND	0.7	2.8	ND	1.4	ND	ND	ND	2.2	ND	2.1	2.2		13.6
8-2-91	ND	ND	0.7	ND	1.4	1.4	ND	ND	1.4	ND	2.1	ND		9.5
8-7-91	ND	ND	0.7	ND	1.4	1.5	ND	ND	1.4	ND	2.9	7.8		5.8
LTS														
8-12-91	ND	ND	2.8	ND	ND	ND	ND	ND	ND	ND	ND	2.1	3.6	
8-19-91	ND	0.7	ND	ND	0.7	2.8	ND	2.1	2.1	ND	0.7	2.1	3.5	
8-26-91	ND	1.1	0.4	ND	0.7	ND	ND	0.7	ND	ND	0.7	ND	2.7	
8-30-91	ND	1.1	ND	ND	0.7	0.4	ND	1.1	1.1	ND	0.4	0.7	--	
9-3-91	ND	0.4	0.7	ND	ND	0.4	ND	ND	3.9	ND	0.4	ND	4.3	
9-9-91	ND	ND	0.4	ND	ND	0.4	ND	ND	ND	ND	ND	1.0	2.8	
9-16-91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5	
9-20-91	ND	ND	ND	ND	ND	0.7	ND	ND	1.1	ND	0.4	ND	--	

TABLE 4-1
(Concluded)

Sampling Date	TCE Concentrations (ppm)													
	P-5A	P-5B	P-5C	P-6A	P-6B	P-6C	P-7A	P-7B	P-7C	P-8A	P-8B	P-8C	VES-3	VES-4
9-23-91	ND	0.7	0.7	ND	ND	2.0	ND	ND	ND	ND	0.3	1.0	3.6	
10-1-91	ND	0.5	1.2	ND	0.7	1.4	ND	1.1	1.6	ND	0.5	ND	2.8	
10-7-91	ND	0.7	0.4	ND	0.9	2.1	ND	0.7	2.3	ND	0.5	1.6	3.2	
LTD														
10-11-91	ND	0.5	1.6	ND	0.7	1.2	ND	0.4	2.0	ND	ND	1.9		--
10-15-91	ND	0.3	0.7	ND	0.4	ND	ND	ND	ND	ND	0.4	2.1		2.6
10-21-91	ND	ND	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND		2.8
10-28-91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	ND		2.4
11-1-91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		2.7
11-4-91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		2.7
11-11-91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		--
11-18-91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		2.4
12-2-91	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	0.2	1.4		2.7
12-9-91	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	0.4	0.4		1.7
12-16-91	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	0.4		2.8

-- Sample not taken (recovery phase)
ND Non Detect
STS Short-term, shallow well (VES-3) extraction
STD Short-term, deep well (VES-4) extraction
LTS Long-term, shallow well (VES-4) extraction
LTD Long-term, deep well (VES-4) extraction

TABLE 4-2

SVE PILOT STUDY
SUMMARY OF TYPICAL OPERATING CONDITIONS

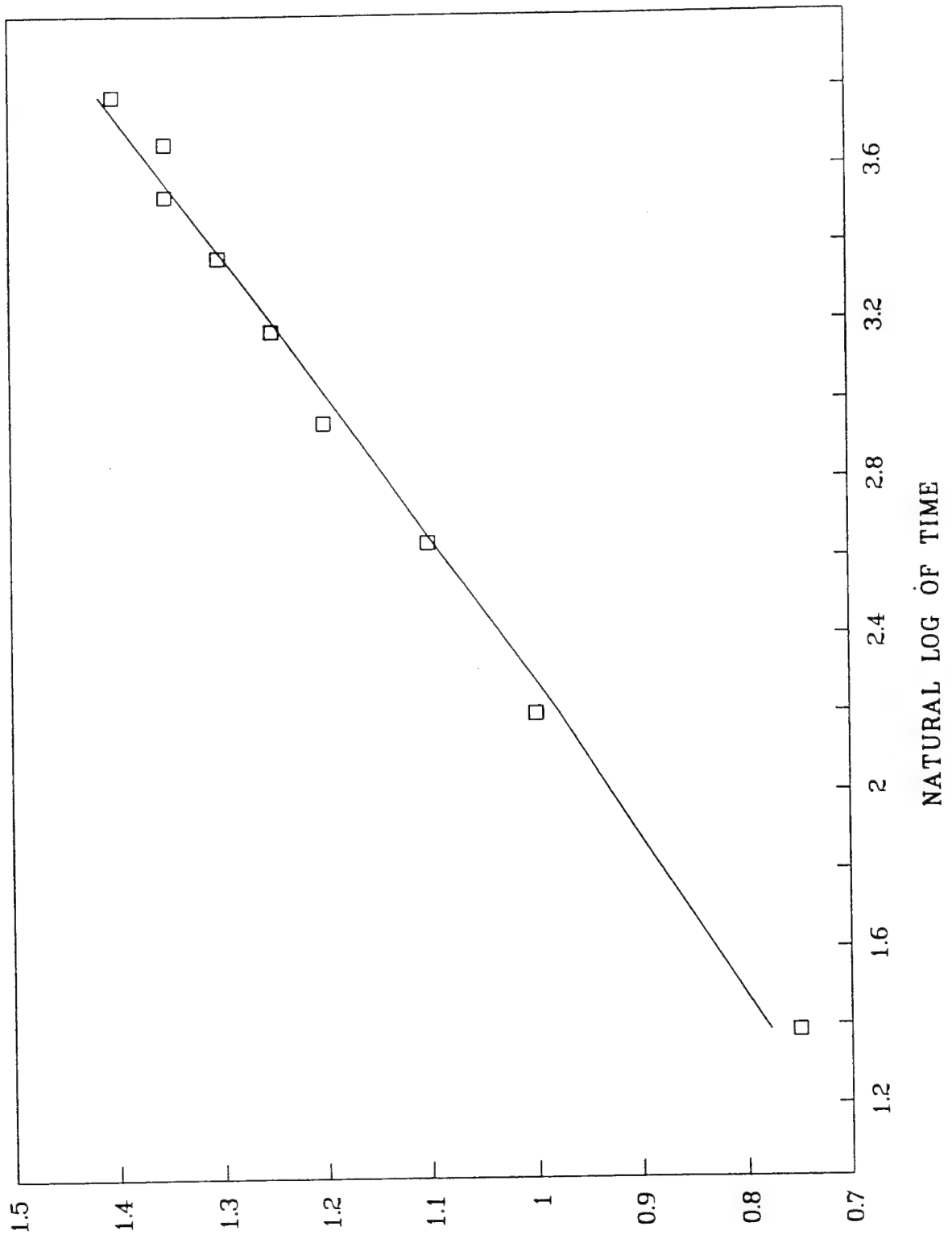
Well	Vacuum (in. H_2O)
VES-3	0 - 13.8
VES-4	0 - 30
P-5A	0 - 0.74
P-5B	0 - 0.50
P-5C	0 - 0.50
P-6A	0.10 - 1.2
P-6B	0.4 - 1.55
P-6C	0 - 2.05
P-7A	0.32 - 1.80
P-7B	0.30 - 3.0
P-7C	0.30 - 3.05
P-8A	0 - 1.85
P-8B	0 - 2.10
P-8C	0 - 2.30

Separator Tank Vacuum (PI-1): 18.2 - 36.5 in H_2O
Separator Level Gauge: 0 inches
Blower Exhaust Temperature (TI-1): 123 - 153°F
Blower Exhaust Pressure (PI-2): 8 - 12 in H_2O
Blower Exhaust (SP-1):

- HNU: 0 - 20 ppm
- Sensidyne: 0 - 15 ppm
- Velocity: 2,600 - 6,000 ft/min.
- Flow Rate: 145 - 335 cfm

GAC Exhaust Temp (TI-2): 85 - 138°F
GAC Exhaust Concentration (SP-5) (13.7 lbs/day state emission limit):

- HNU: 0 - 3.7 ppm
- Sensidyne: 0 ppm

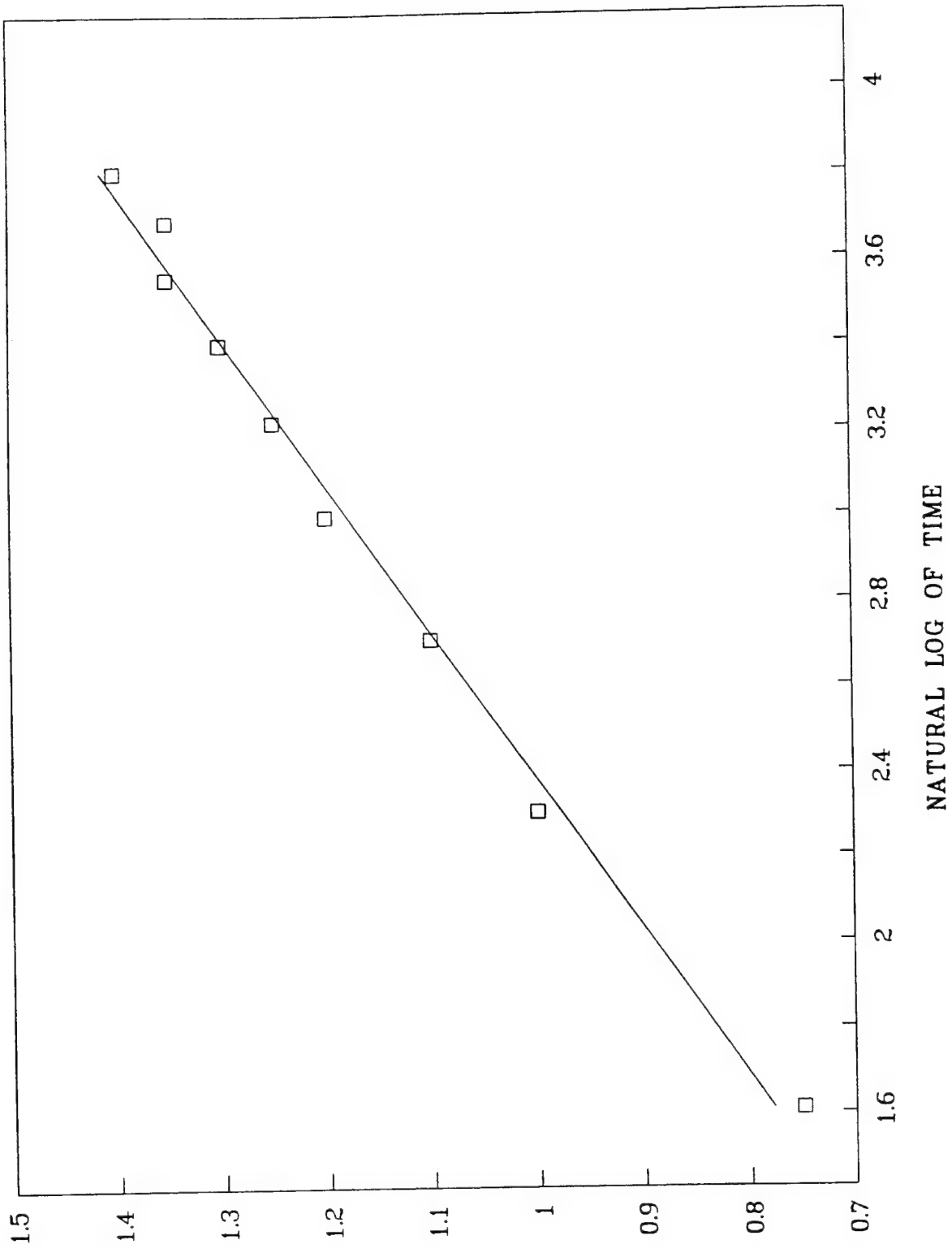


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

SOIL PERMEABILITY STUDY (VES-3)

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-1



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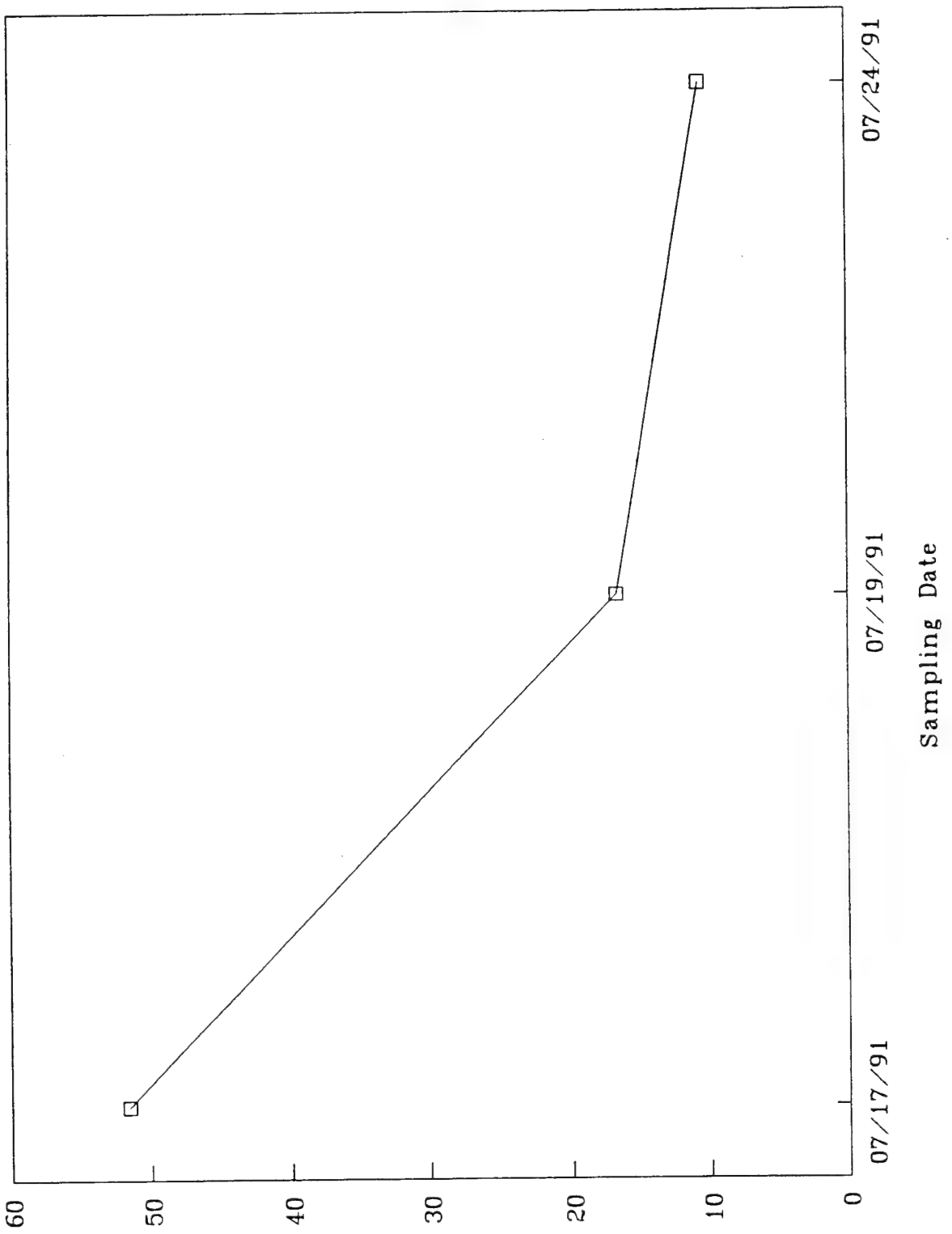
SOIL PERMEABILITY STUDY (VES-4)

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-2



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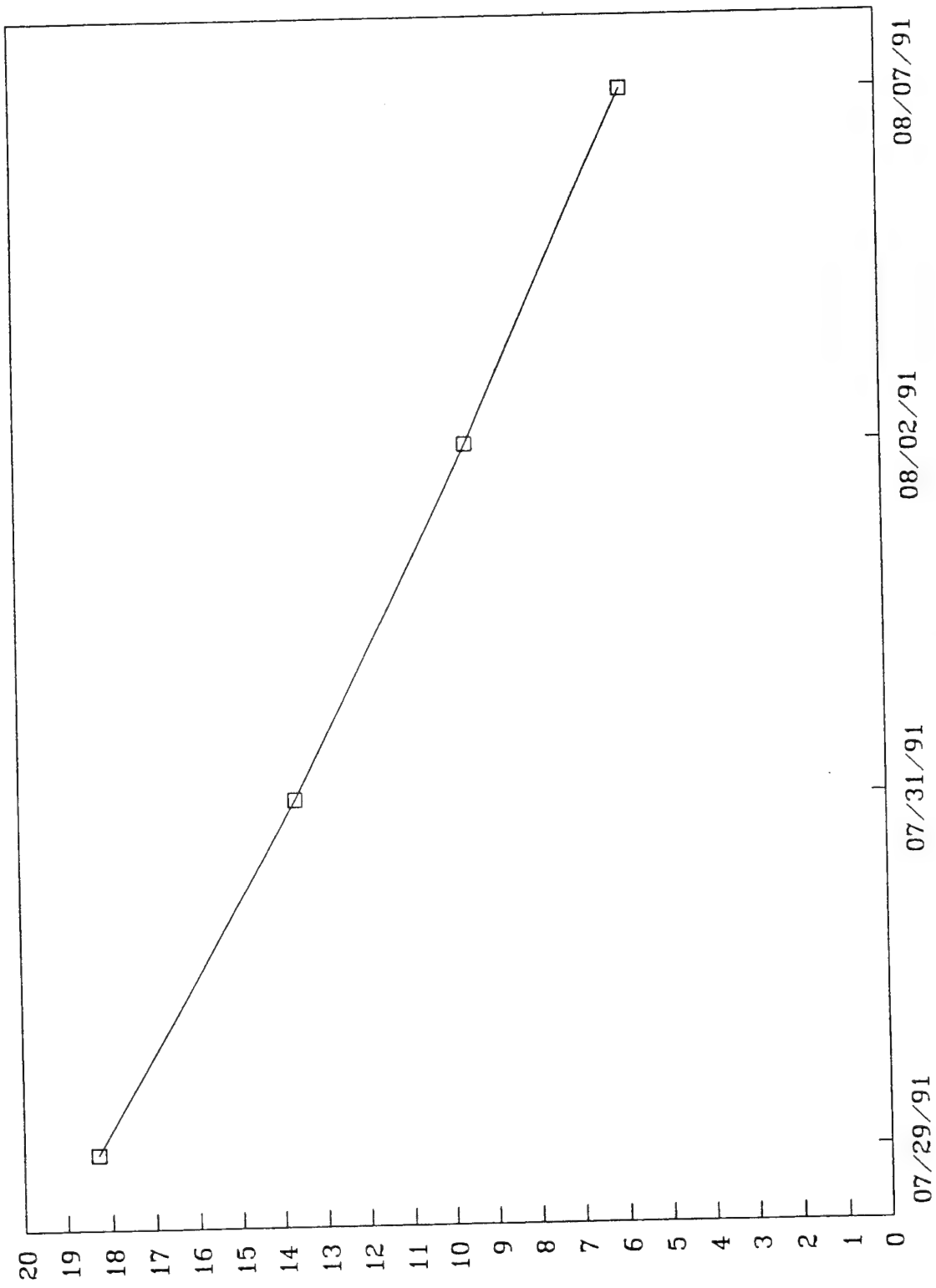
Date :	1/21/92

VES-3 SHALLOW WELL SHORT TERM RESULTS

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-3



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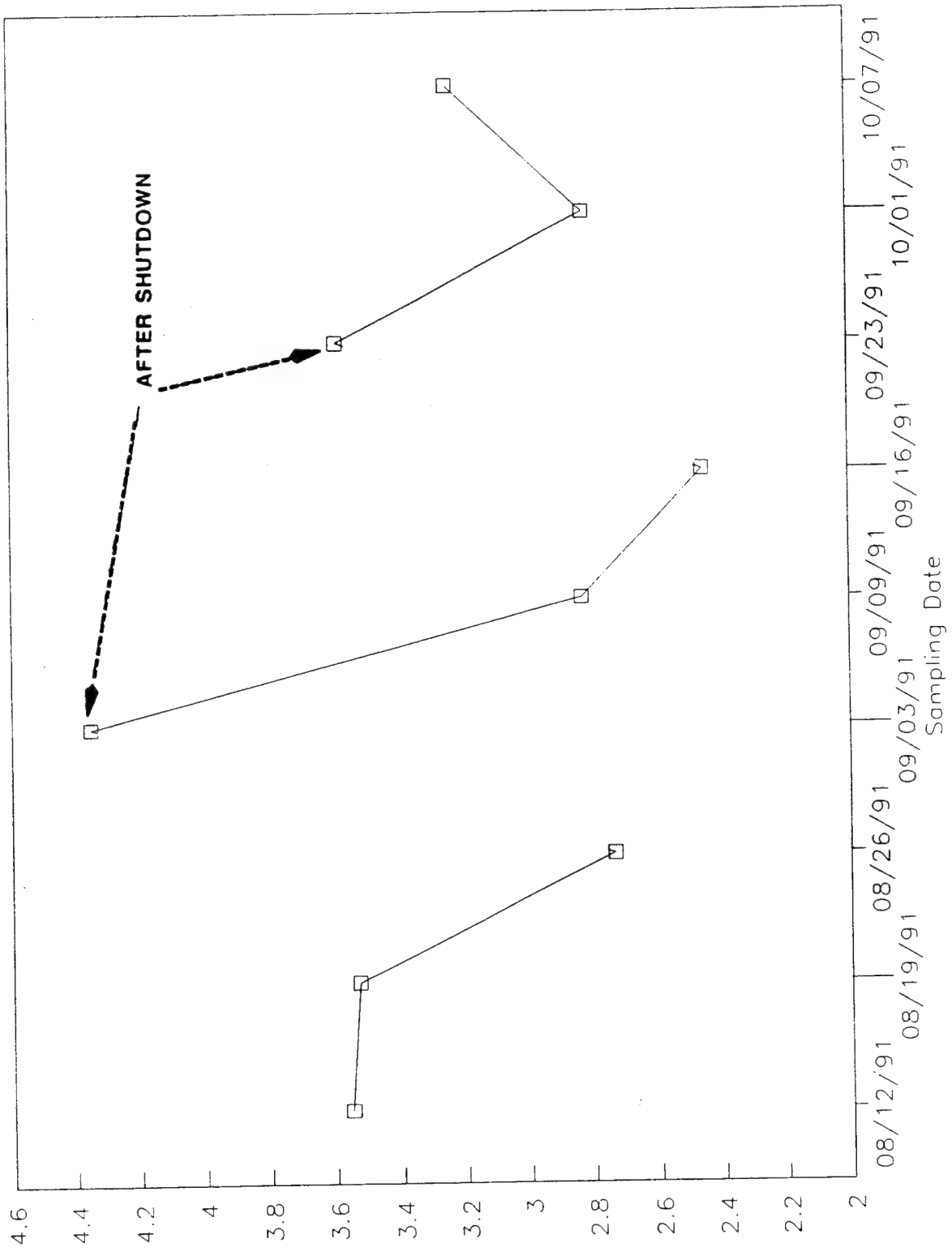
VES-4 DEEP WELL SHORT TERM RESULTS

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-4



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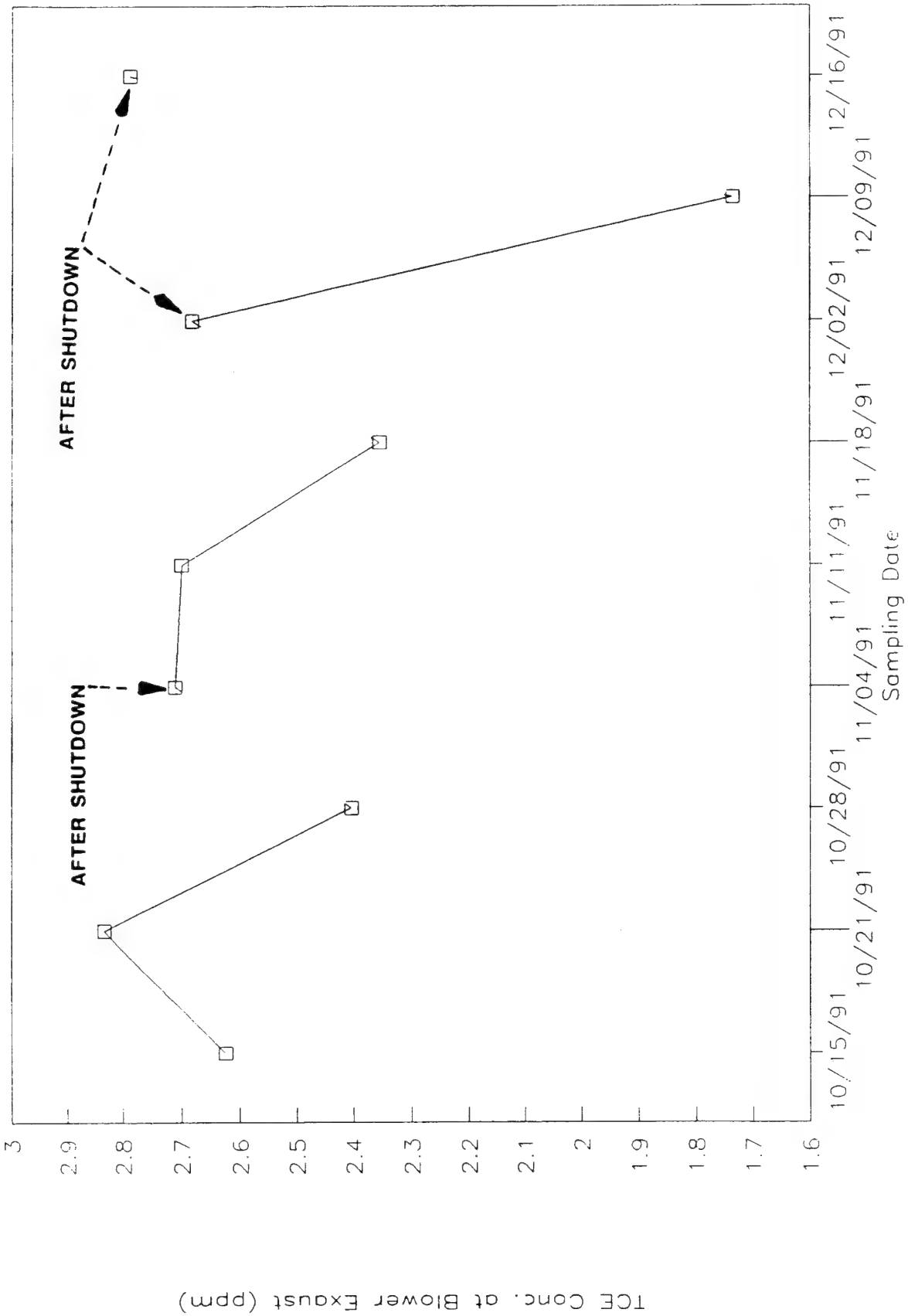
Prepared by :	M.A.G.
Date :	1/21/92

VES-3 SHALLOW WELL LONG TERM RESULTS

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-5



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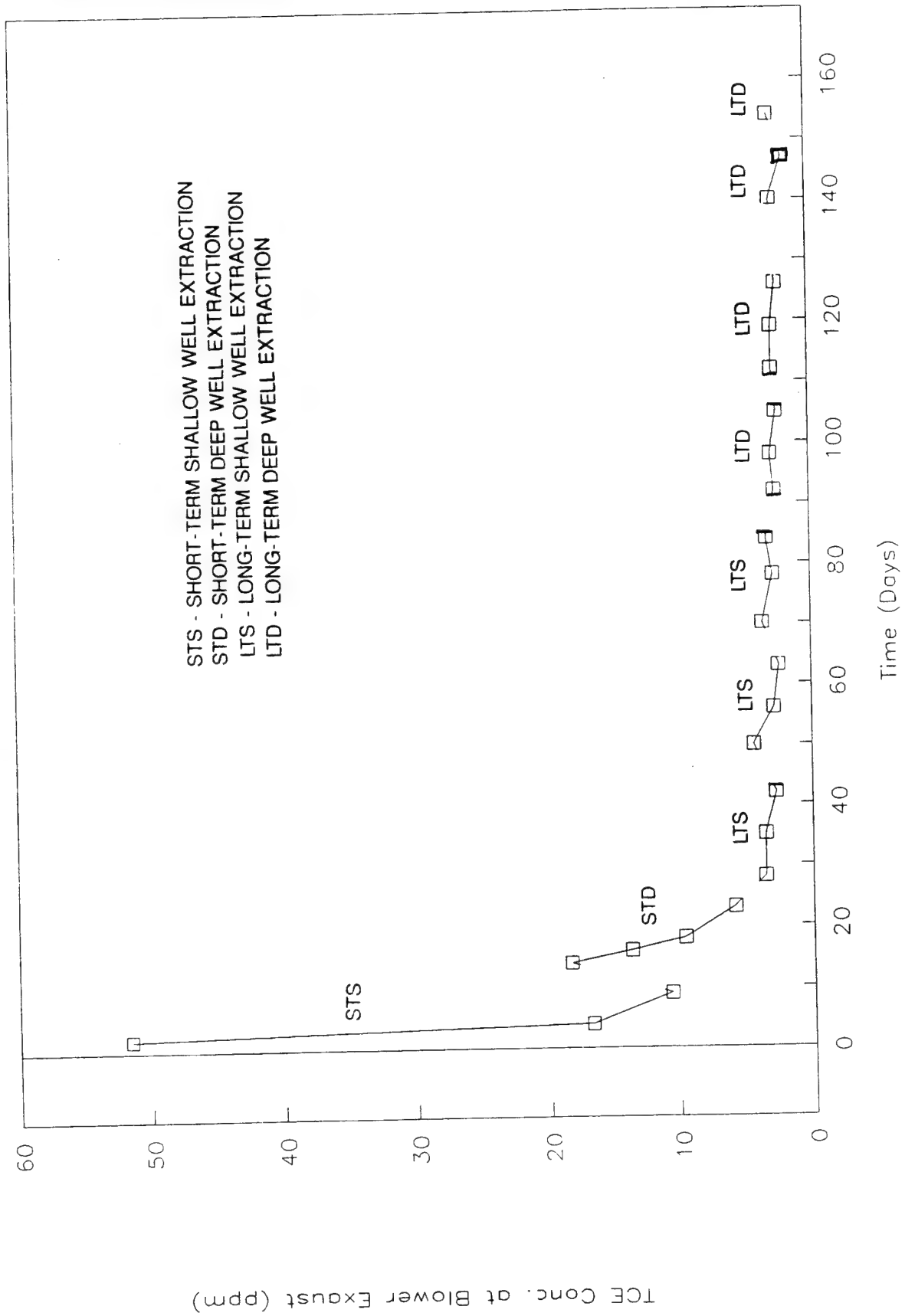
Prepared by :	M.A.G.
Date :	1/21/92

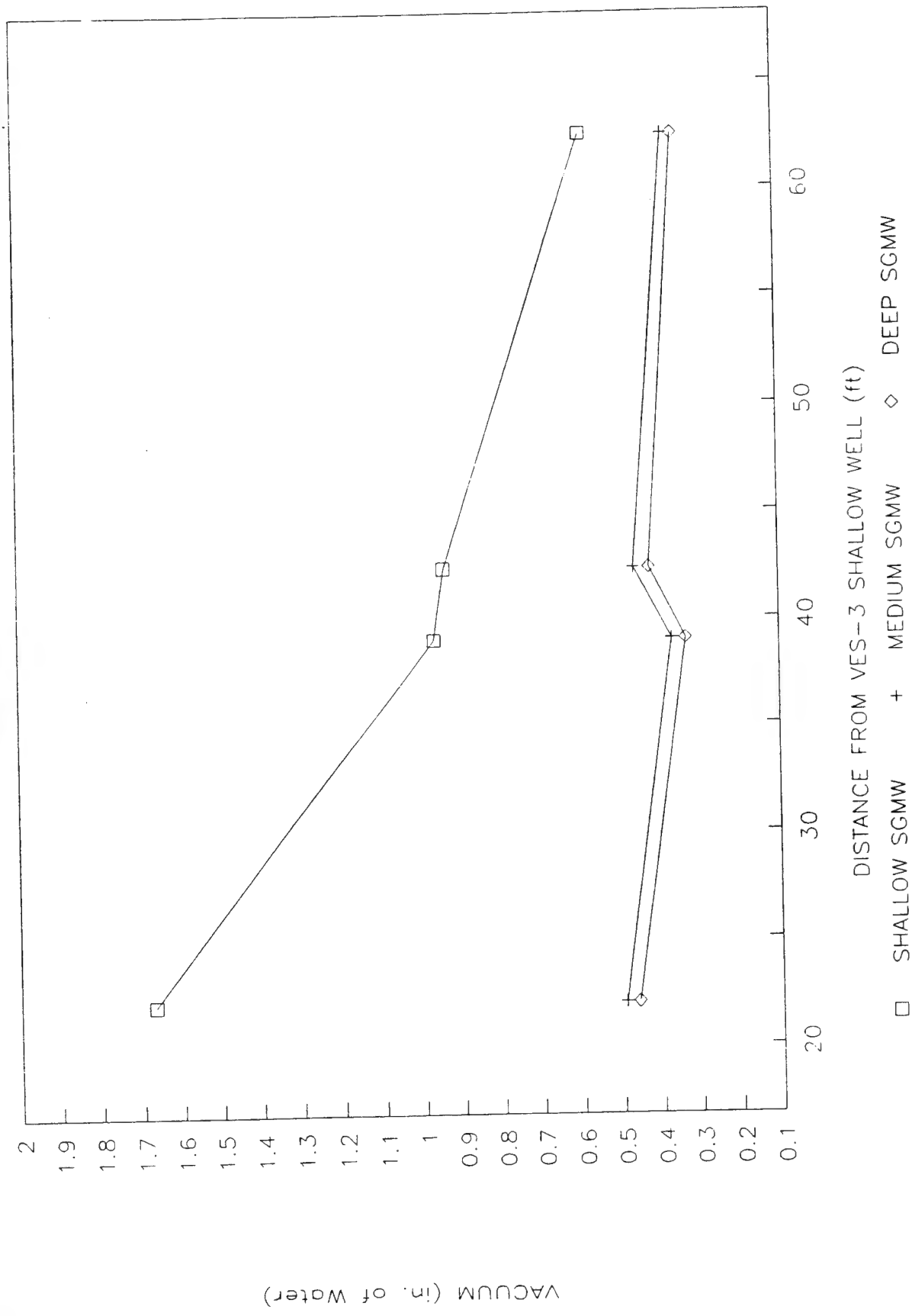
VES-4 DEEP WELL LONG TERM RESULTS

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-6



Job No. : 89MC114G1	**SUMMARY OF LONG AND SHORT TERM OPERATIONS**
Prepared by : M.A.G.	ROCKY MOUNTAIN ARSENAL, COLORADO
Date : 3/30/92	Figure 4-7

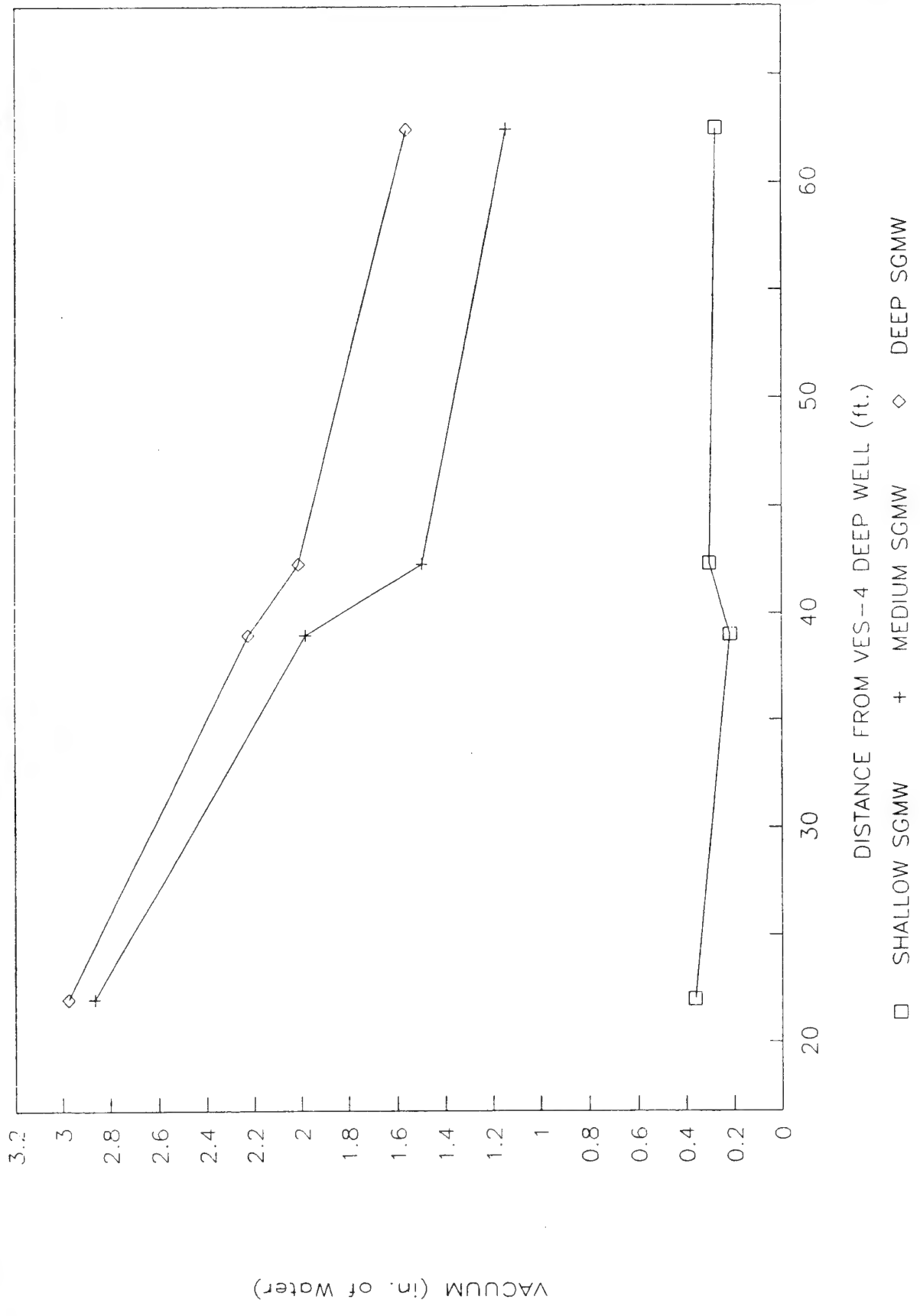


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

SHALLOW EXTRACTION WELL VACUUM READINGS

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-8

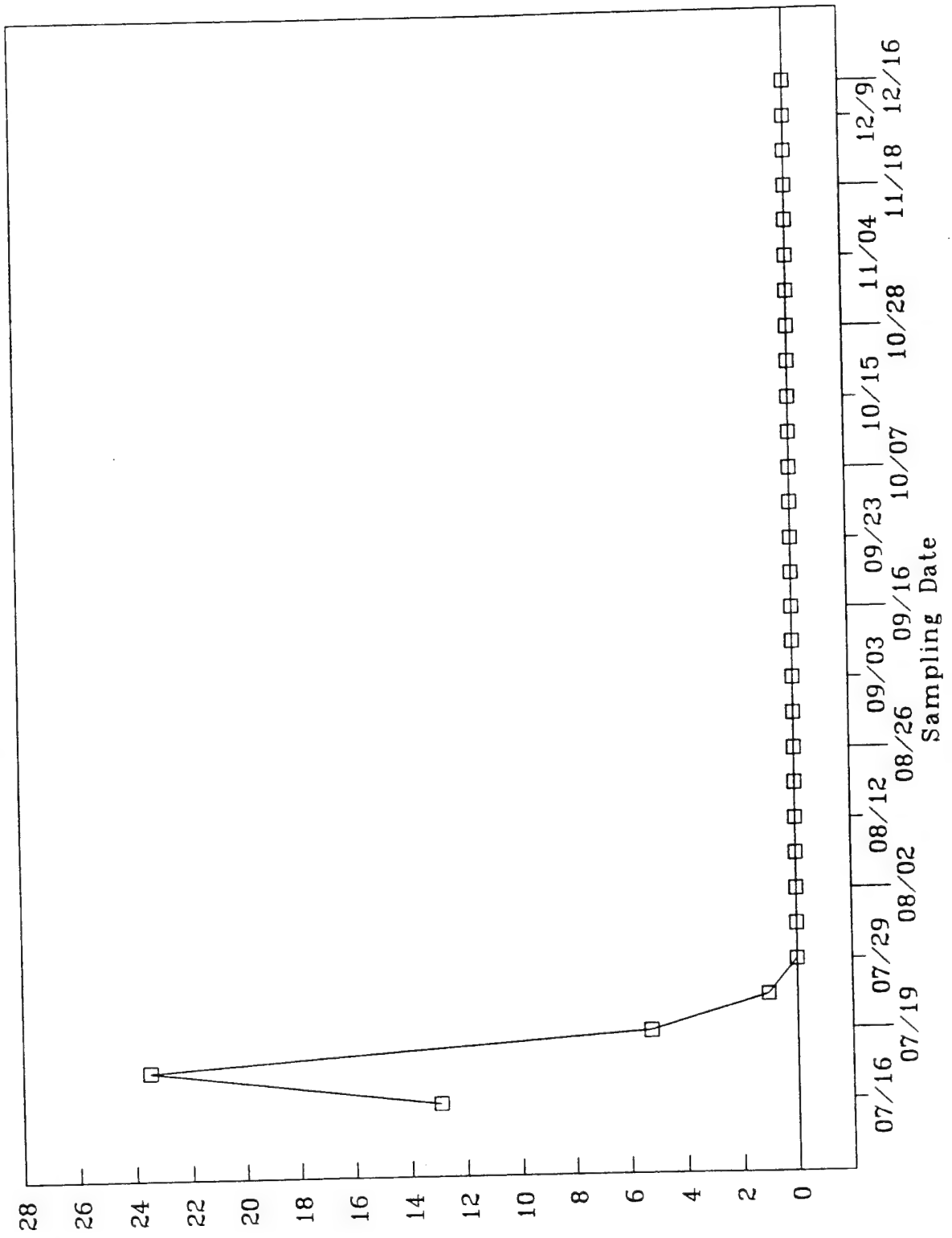


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

DEEP EXTRACTION WELL VACUUM READINGS

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-9

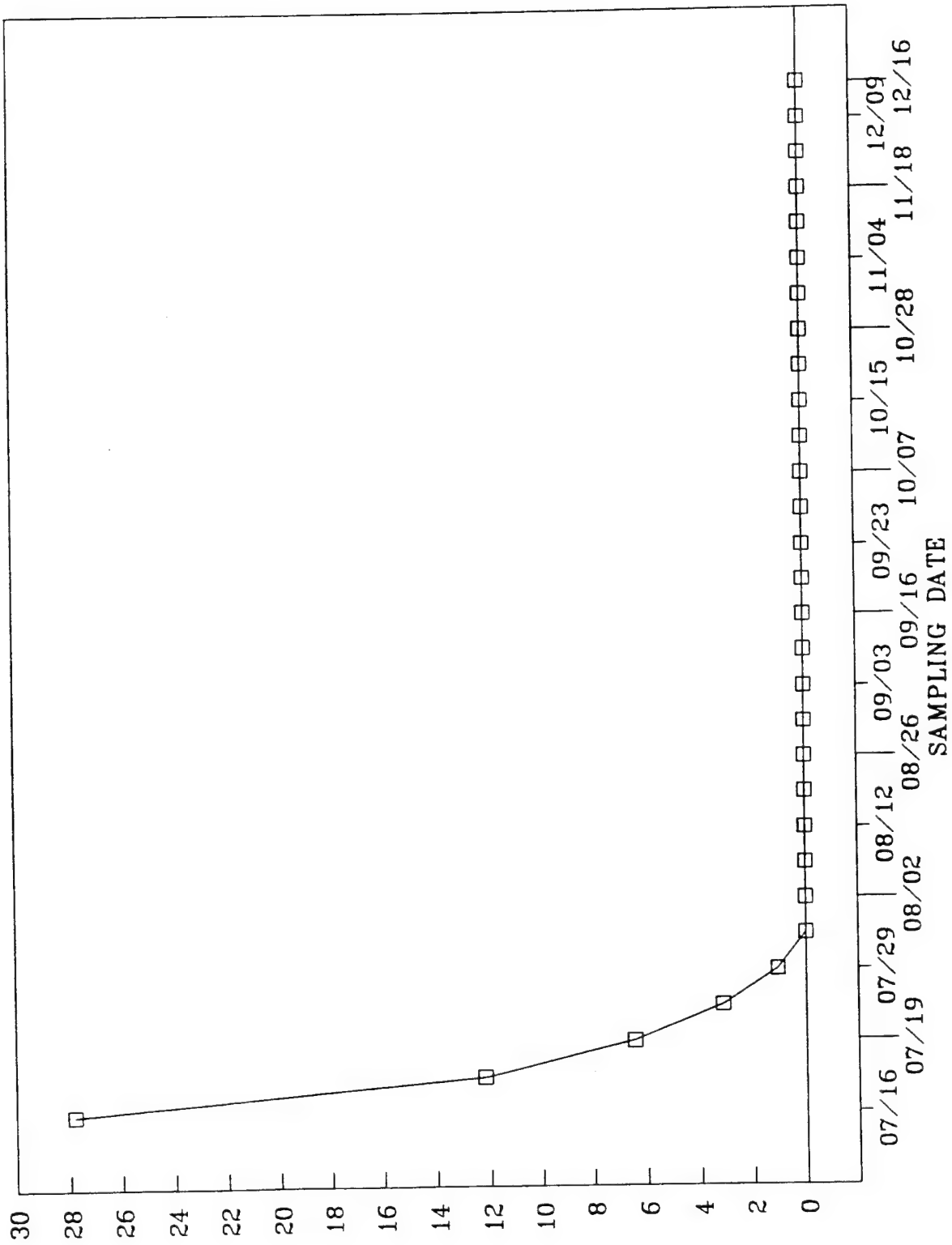


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-5A SHALLOW MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-10

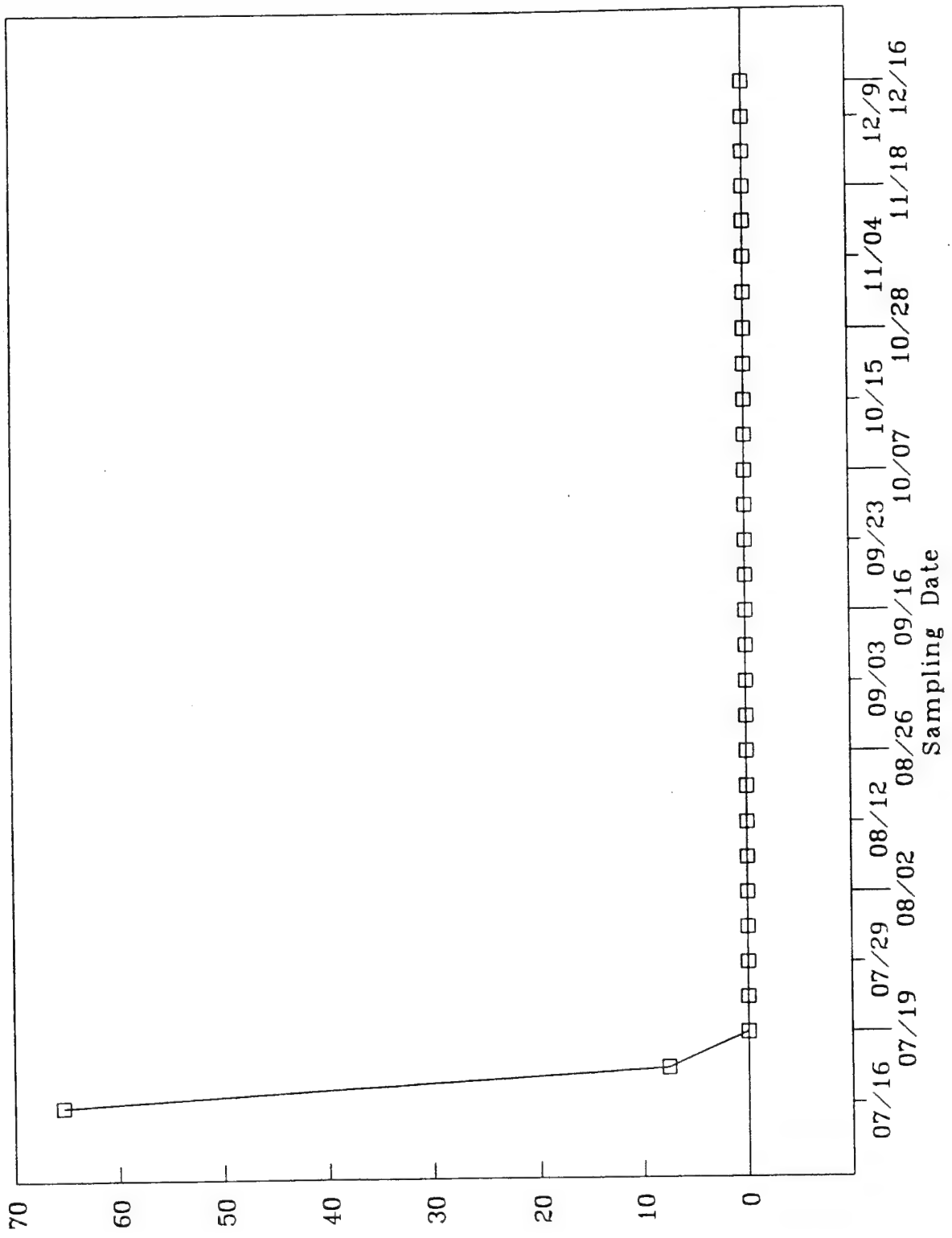


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-6A SHALLOW MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-11

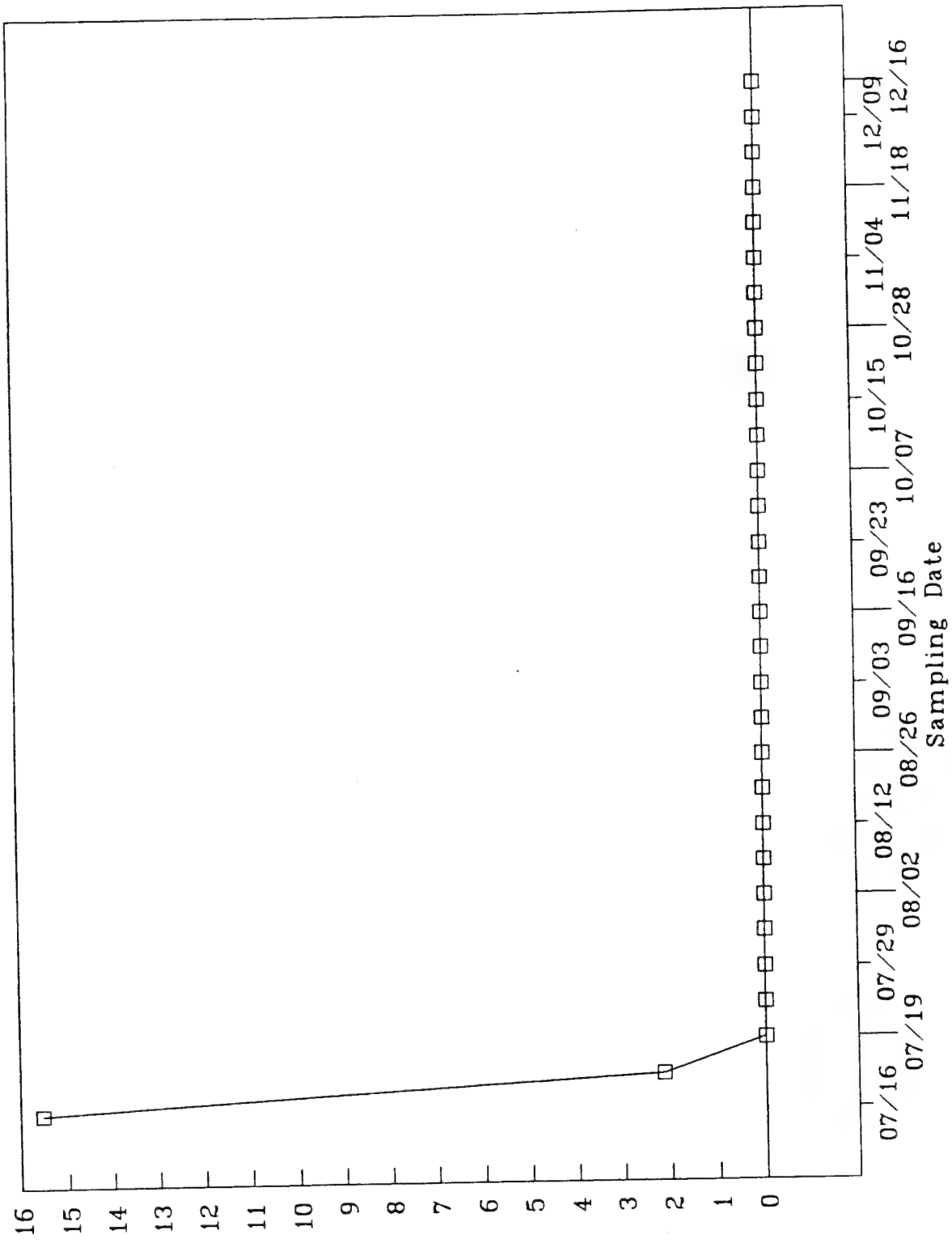


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-7A SHALLOW MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-12

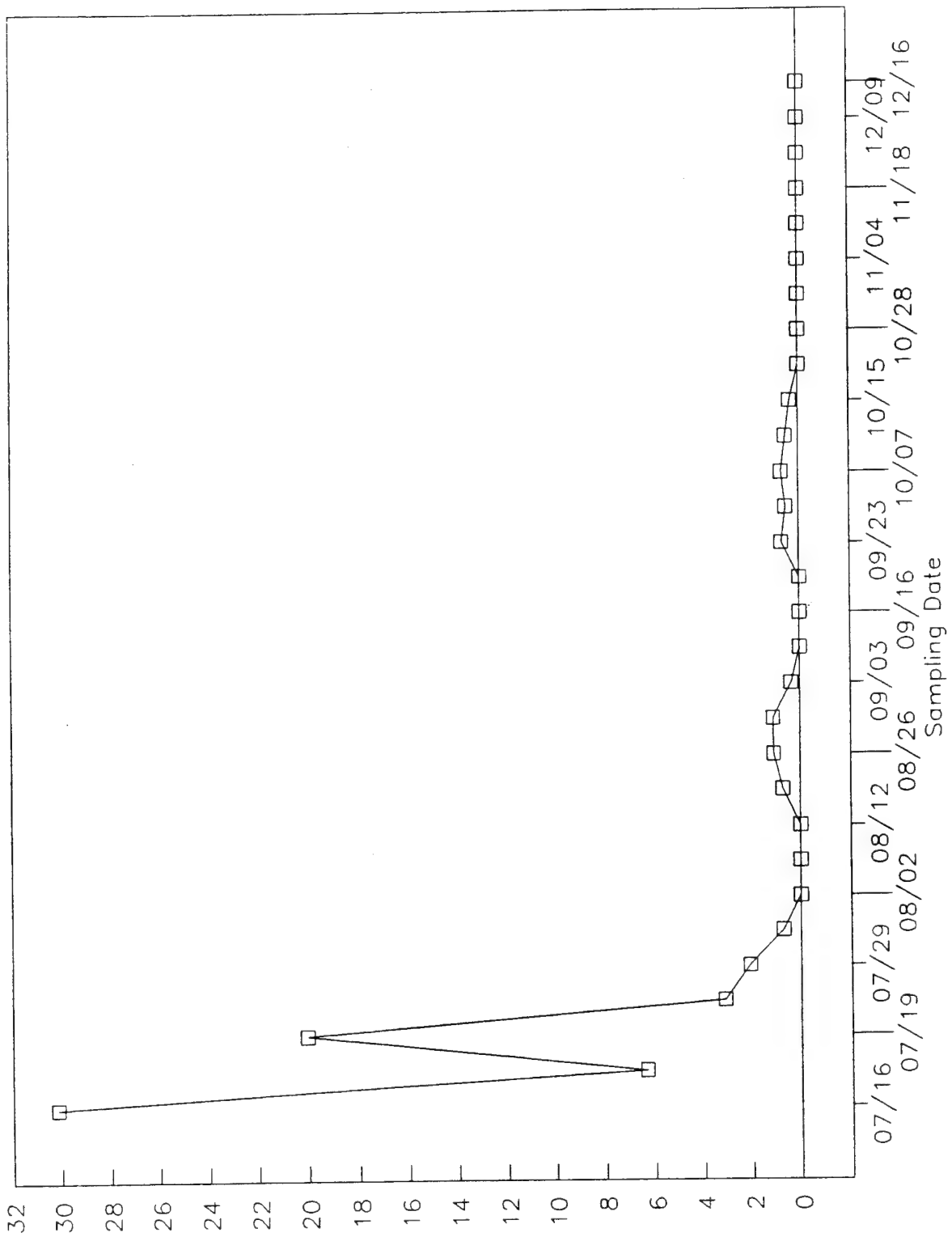


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-8A SHALLOW MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-13

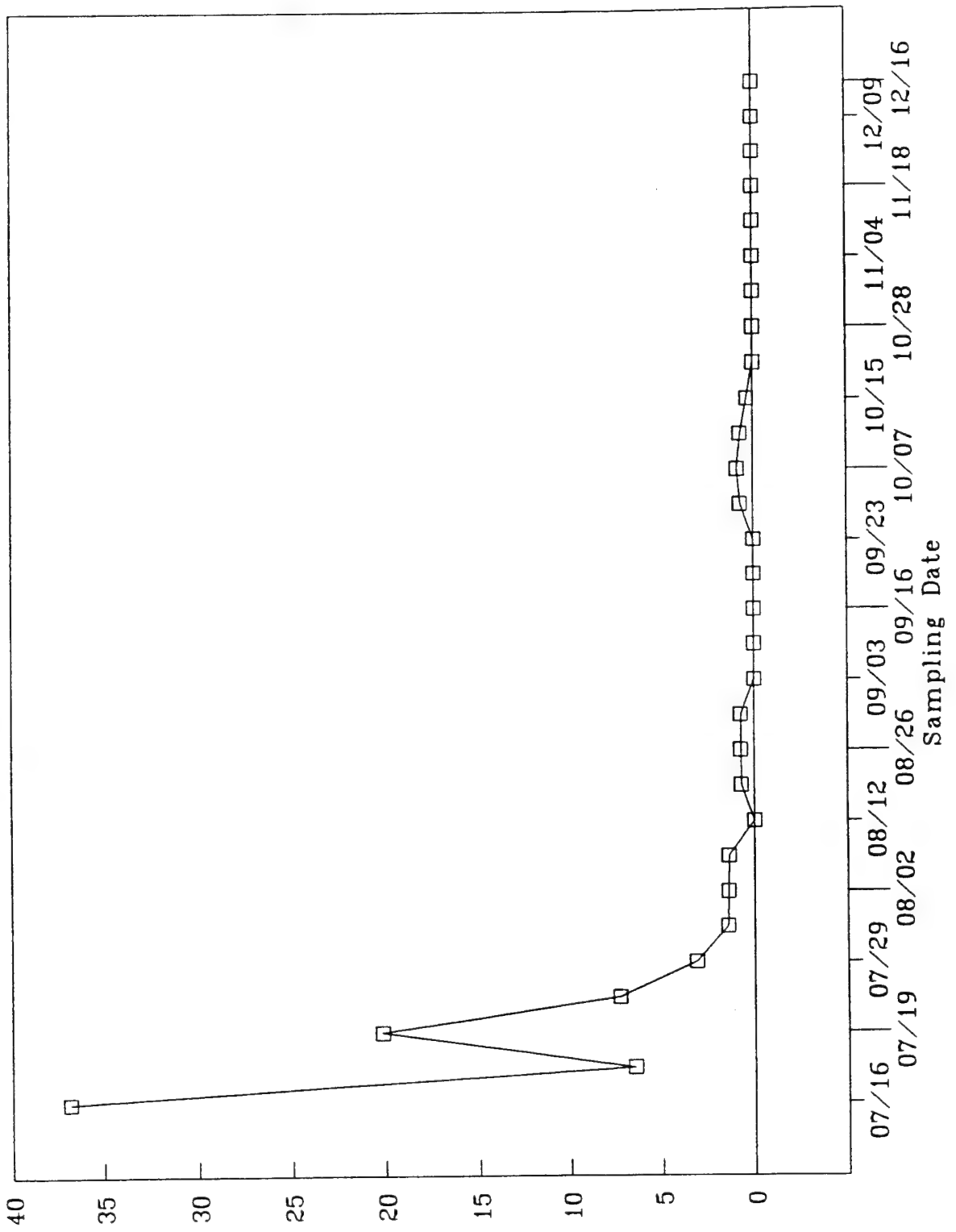


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-5B MEDIUM MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-14

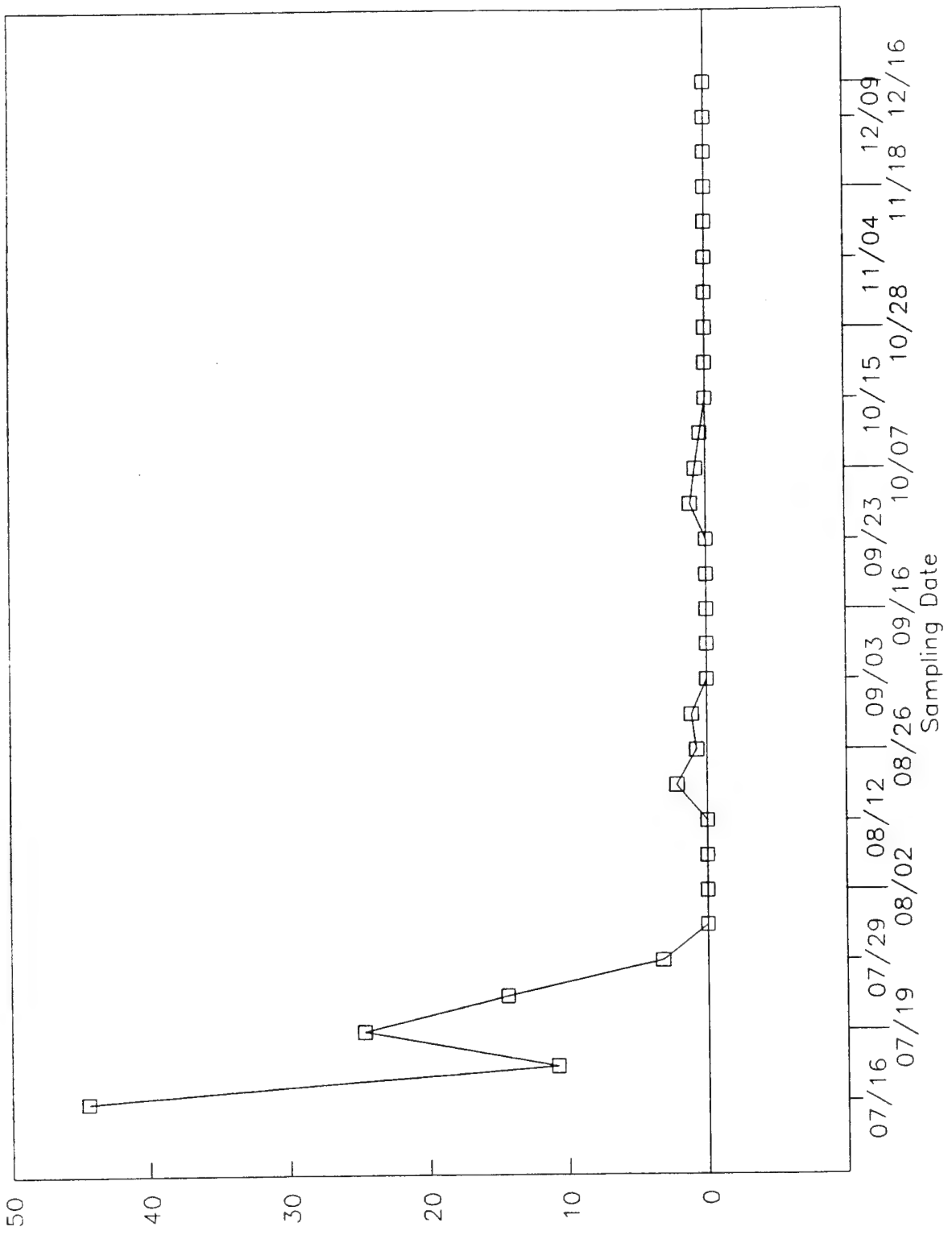


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-6B MEDIUM MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-15

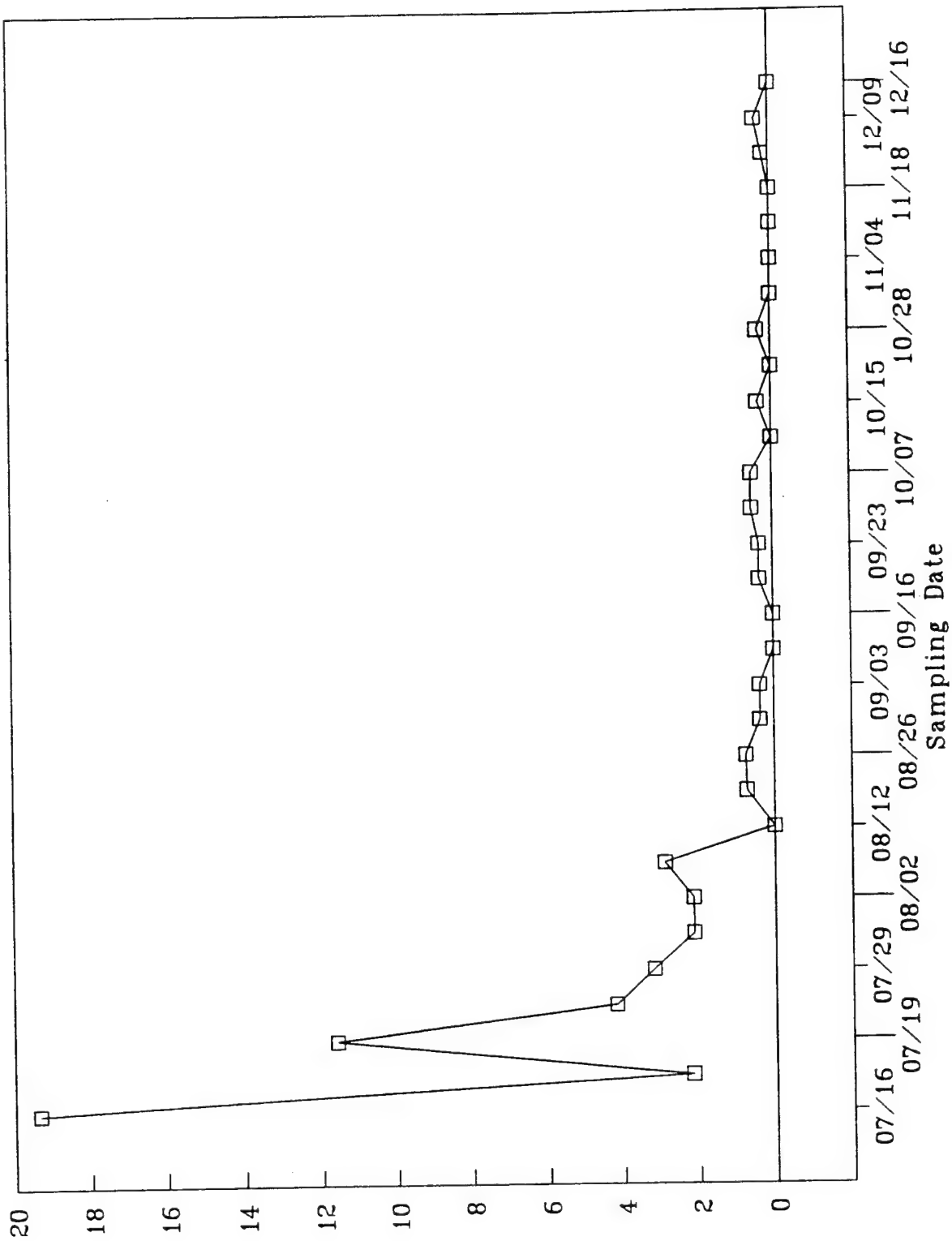


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-7B MEDIUM MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-16

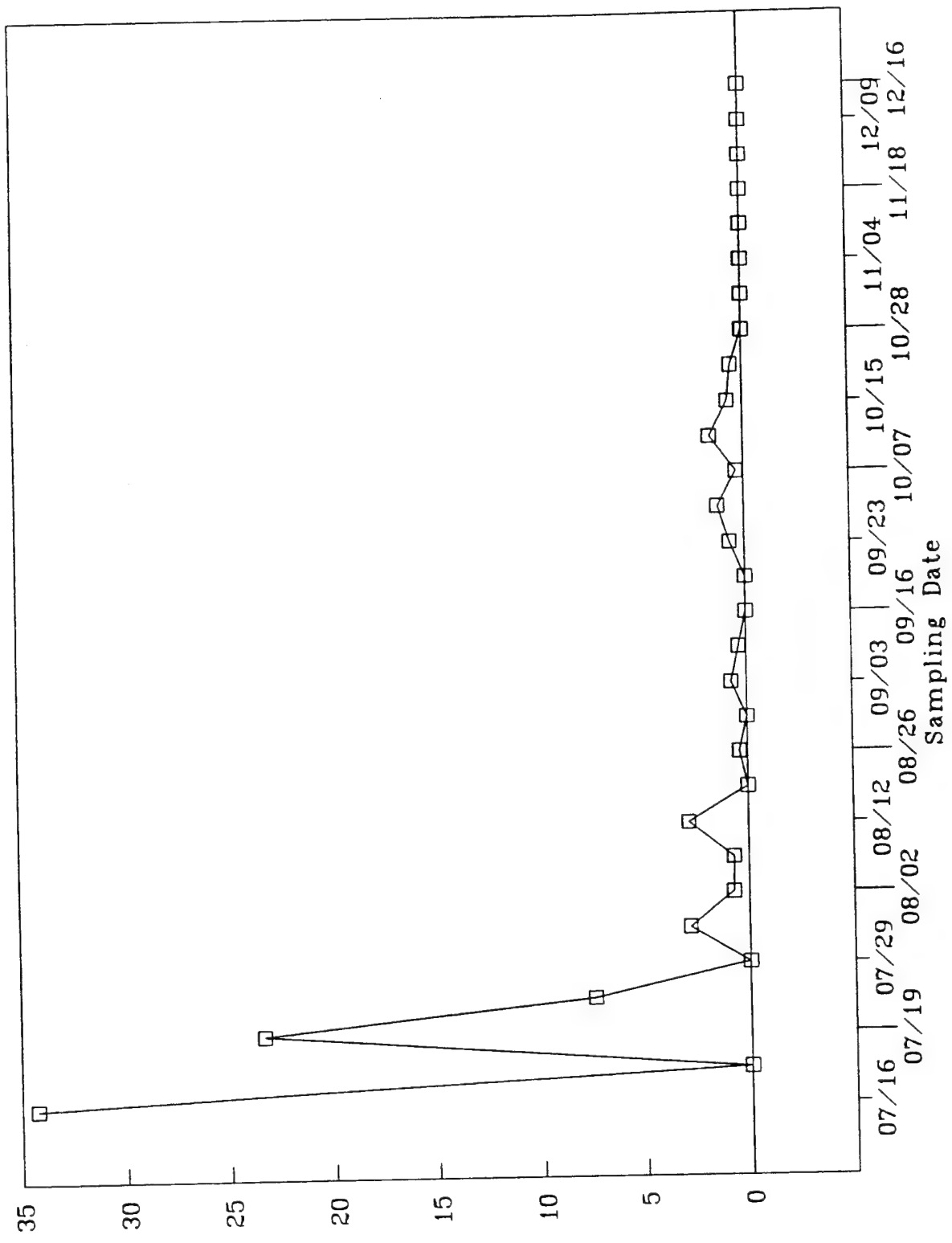


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-8B MEDIUM MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-17

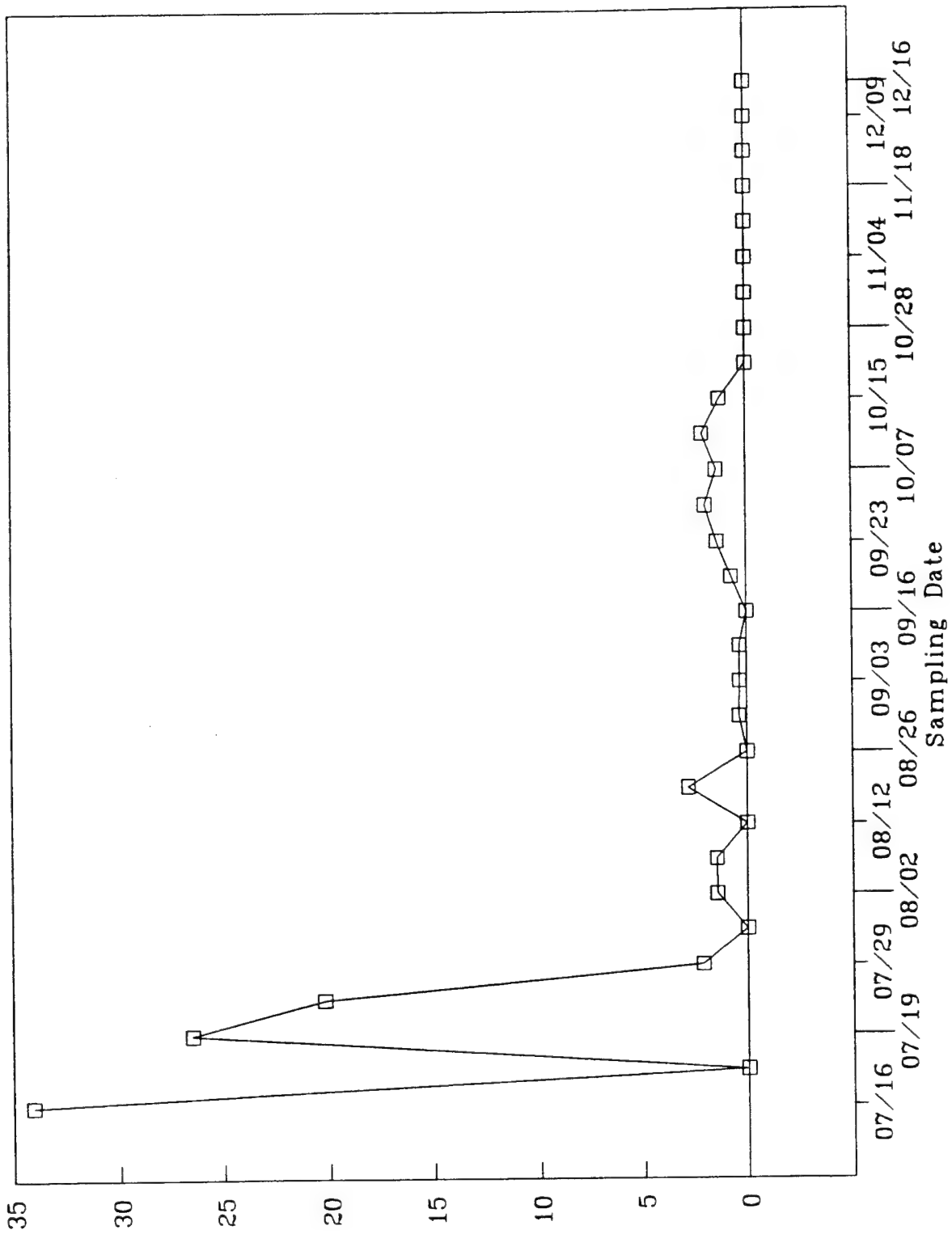


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-5C DEEP MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-18

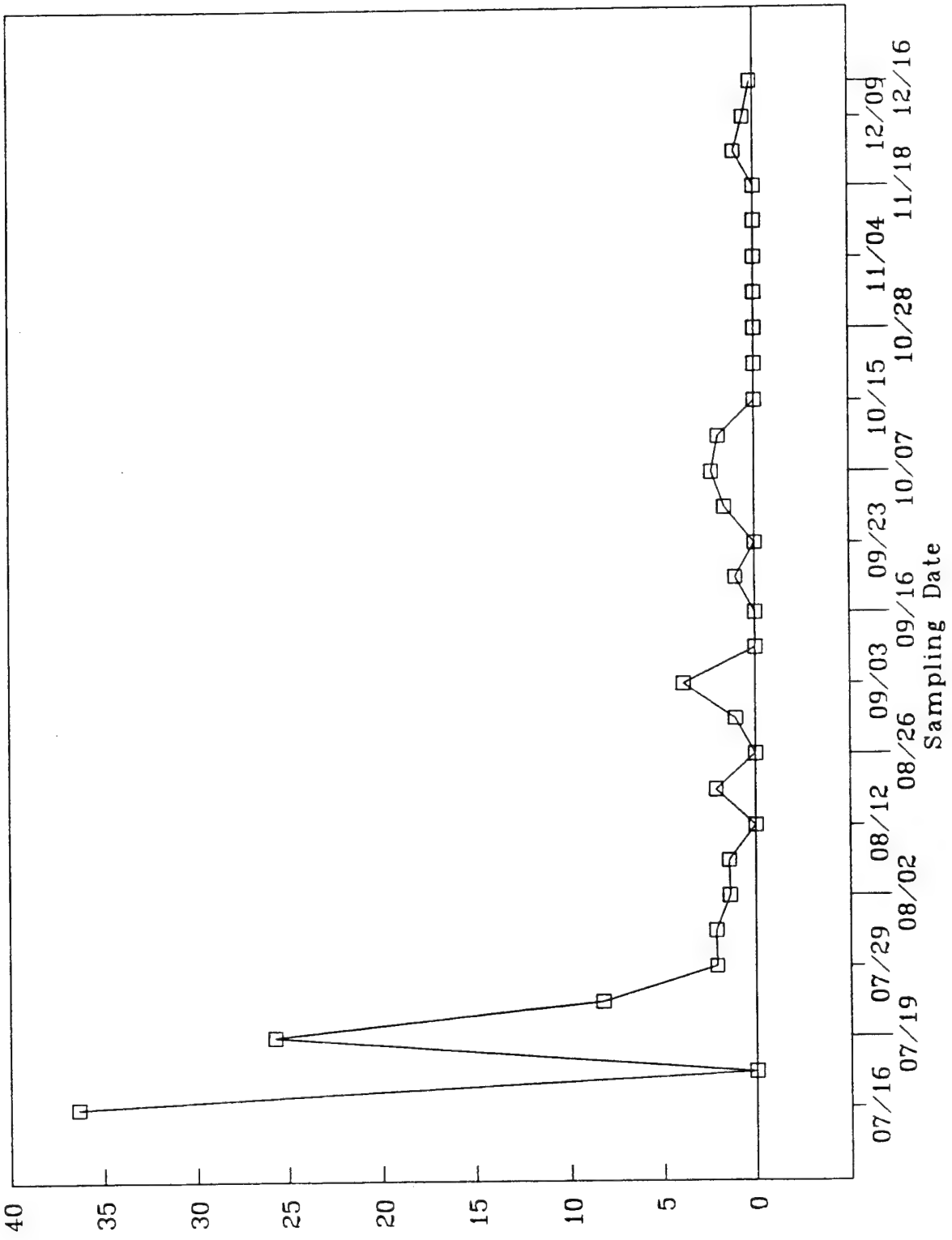


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-6C DEEP MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-19

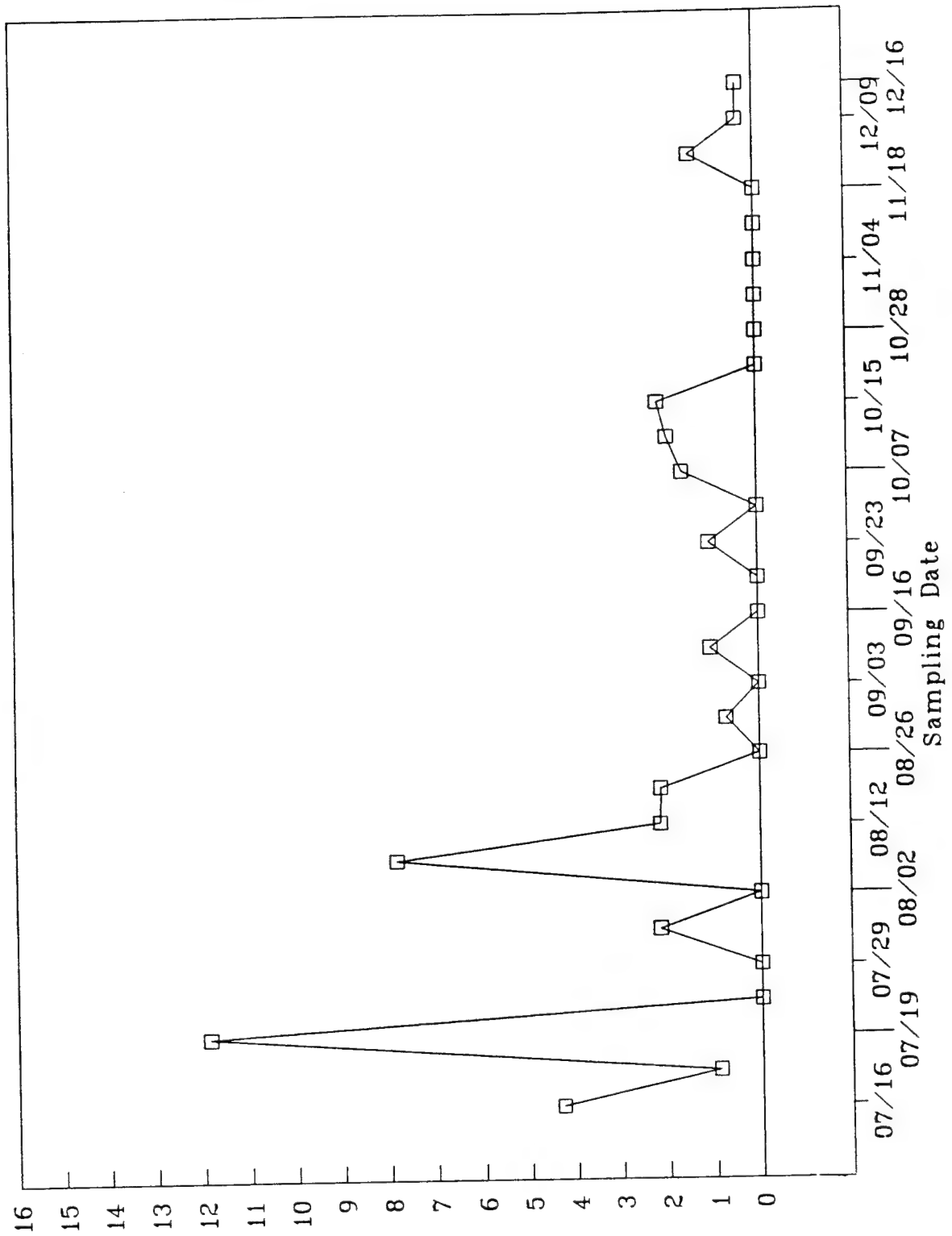


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-7C DEEP MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-20

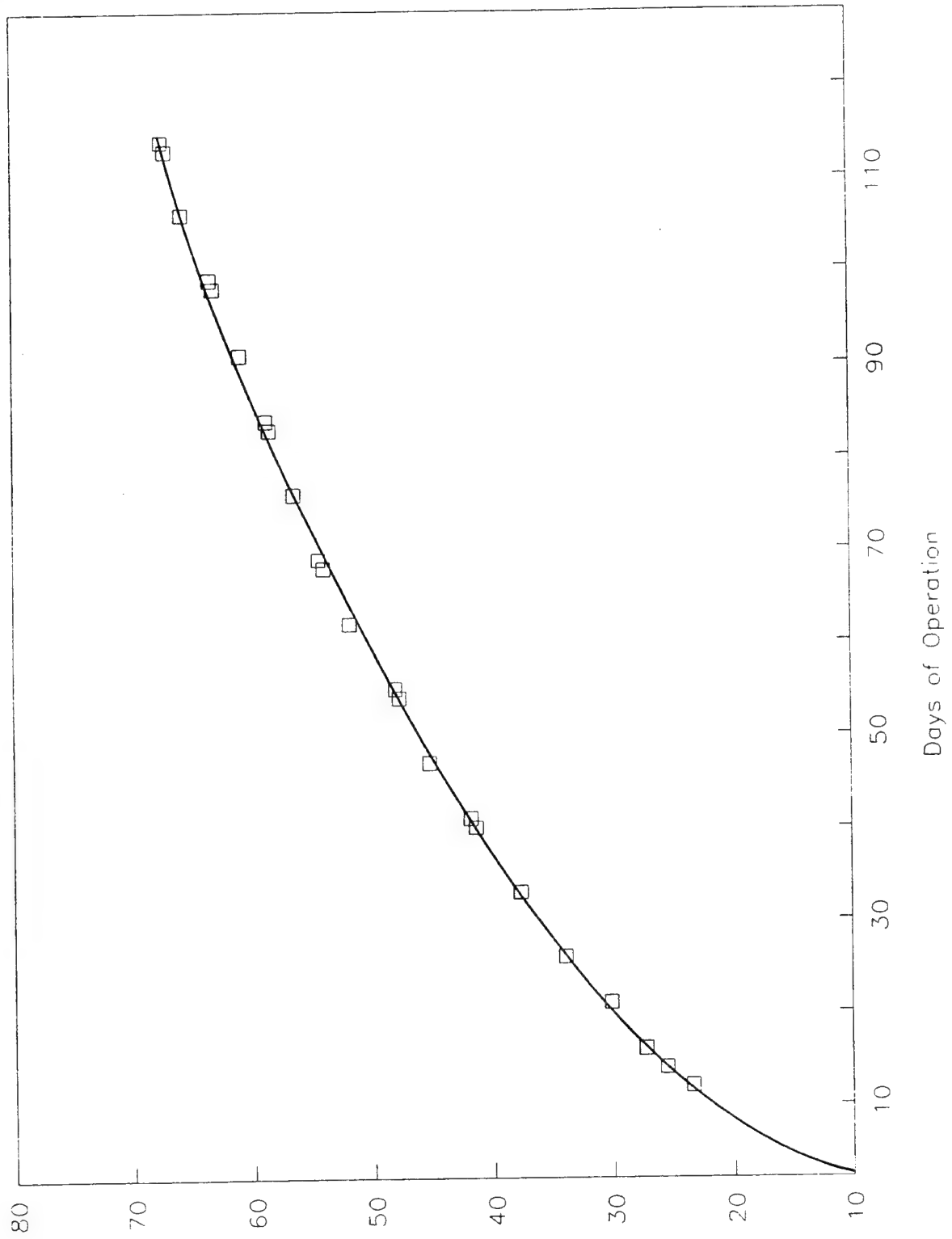


Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

P-8C DEEP MONITORING WELL

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-21



Job No. :	89MC114G1
Prepared by :	M.A.G.
Date :	1/21/92

TOTAL MASS TCE EXTRACTED

ROCKY MOUNTAIN ARSENAL, COLORADO

Figure 4-22

5.0
CONCLUSIONS

Based on the pilot study testing conducted at the Rocky Mountain Arsenal Motor Pool Area, the following can be concluded:

- SVE was an effective remediation technique for removing TCE from the permeable soils found at this site.

- The majority of the TCE contamination was extracted from the shallow and medium regions, which suggests that the clay lens served as a partial vapor barrier to downward migration of TCE. Lower concentrations extracted from the deeper region suggest that re-volatilization of TCE from the groundwater was not a major contribution to the overall mass of TCE removed. It can be concluded the optimum extraction interval was the shallow well.

- Initial observed concentrations of TCE in the soil gas monitoring wells did not exhibit appreciable spacial variations. No conclusions were drawn with respect to horizontal distribution of TCE and potential source areas.

- Based on the vacuum induced in the remote soil gas monitoring probes when extracting from the shallow well, short-circuiting of atmospheric air was not significant, thereby precluding the need for a surface seal.

- TCE concentrations in the soil gas monitoring wells and blower exhaust decreased to non-detectable or low levels over the duration of this pilot study. It can be concluded that soil within the radial influence of the extraction wells (suspected source area) was remediated of TCE and no further extraction is required.

6.0
REFERENCES

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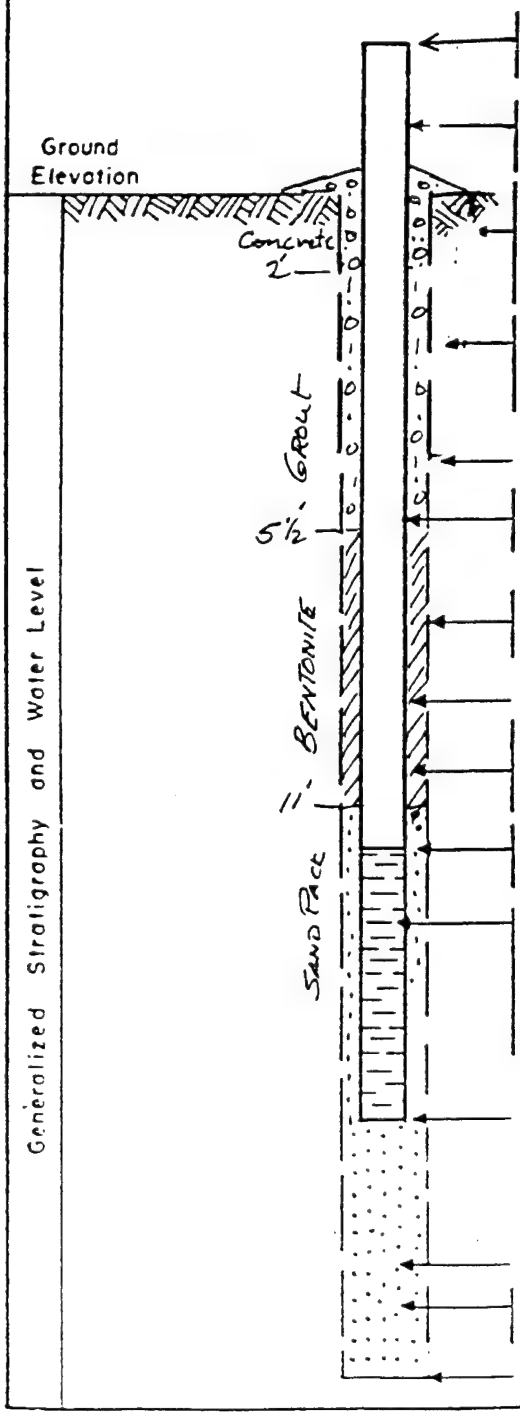
APPENDIX A
WELL CONSTRUCTION DETAILS

GROUNDWATER MONITORING WELL AND PIEZOMETER REPORT

PROJECT RMACOE MOTOR POOL VES 89M114G1
LOCATION SECTION 4 (9948 WCFS)
Date Completed 6/6/91 Original Depth 30'
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VES-3
Aquifer NA
SCREEN Depth Interval 28'-13'

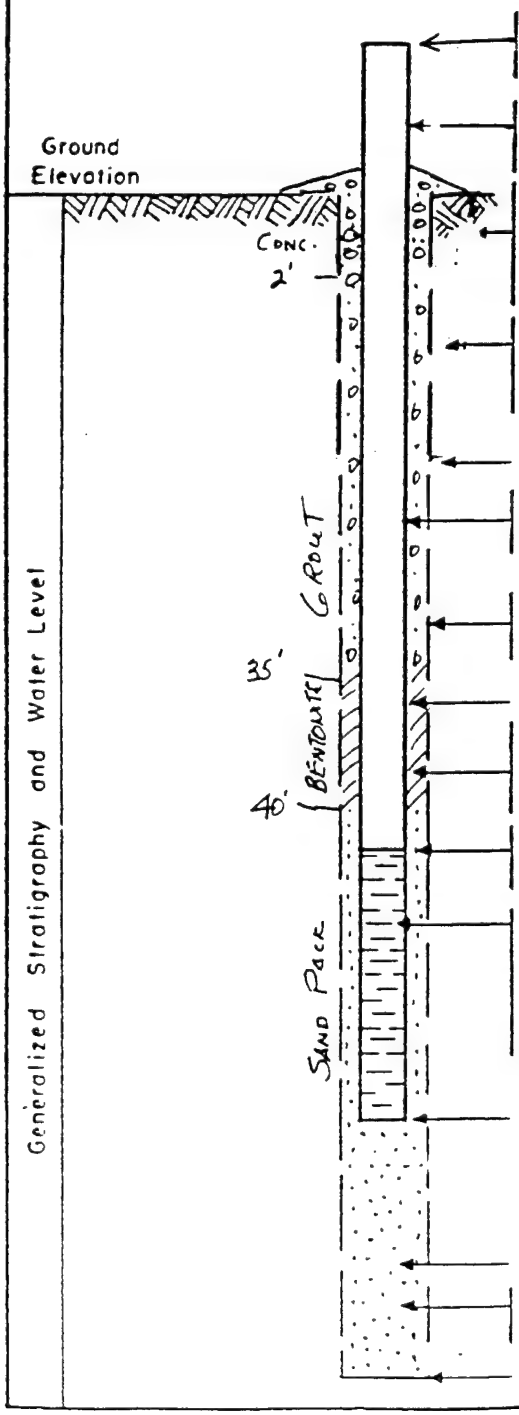


Elevation of top of ~~surface casing~~ / riser pipe.	
Height of top of ~~surface casing~~ / riser pipe above ground surface	20"
Depth of surface seal below ground surface	2'
Type of surface seal: CONCRETE	
I.D. of surface casing. —	—
Type of surface casing:	
Depth of surface casing below ground	—
O.D. of riser pipe.	4"
Type of riser pipe: PVC Sched 40	
Diameter of borehole	10½"
Depth of borehole	30'
Type of backfill: GROUT	
Elev./depth top of seal.	5½
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	11'
Type of sand pack. 20-40 Silica	
Depth of top of sand pack.	11'
Elev./depth top of screened section.	13'
Type of screened section: Sched 40 PVC	
Describe openings: .020" FACTORY SLOTTED	
O.D. of screened section.	1"
Elev./depth bottom of screened section.	28'
Elev./depth bottom of sand column	30'
Type of backfill below observation pipe. 20-40 Silica Sand	
Elev./depth of hole	30'

GROUNDWATER MONITORING WELL AND PIEZOMETER REPORT

PROJECT RMACOE MOTOR POOL VES 89M1146I
LOCATION SECTION 4 (9948 WCFS)
Date Completed 6/7/91 Original Depth 60'
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VES-4
Aquifer NA
SCREEN Depth Interval 58-43

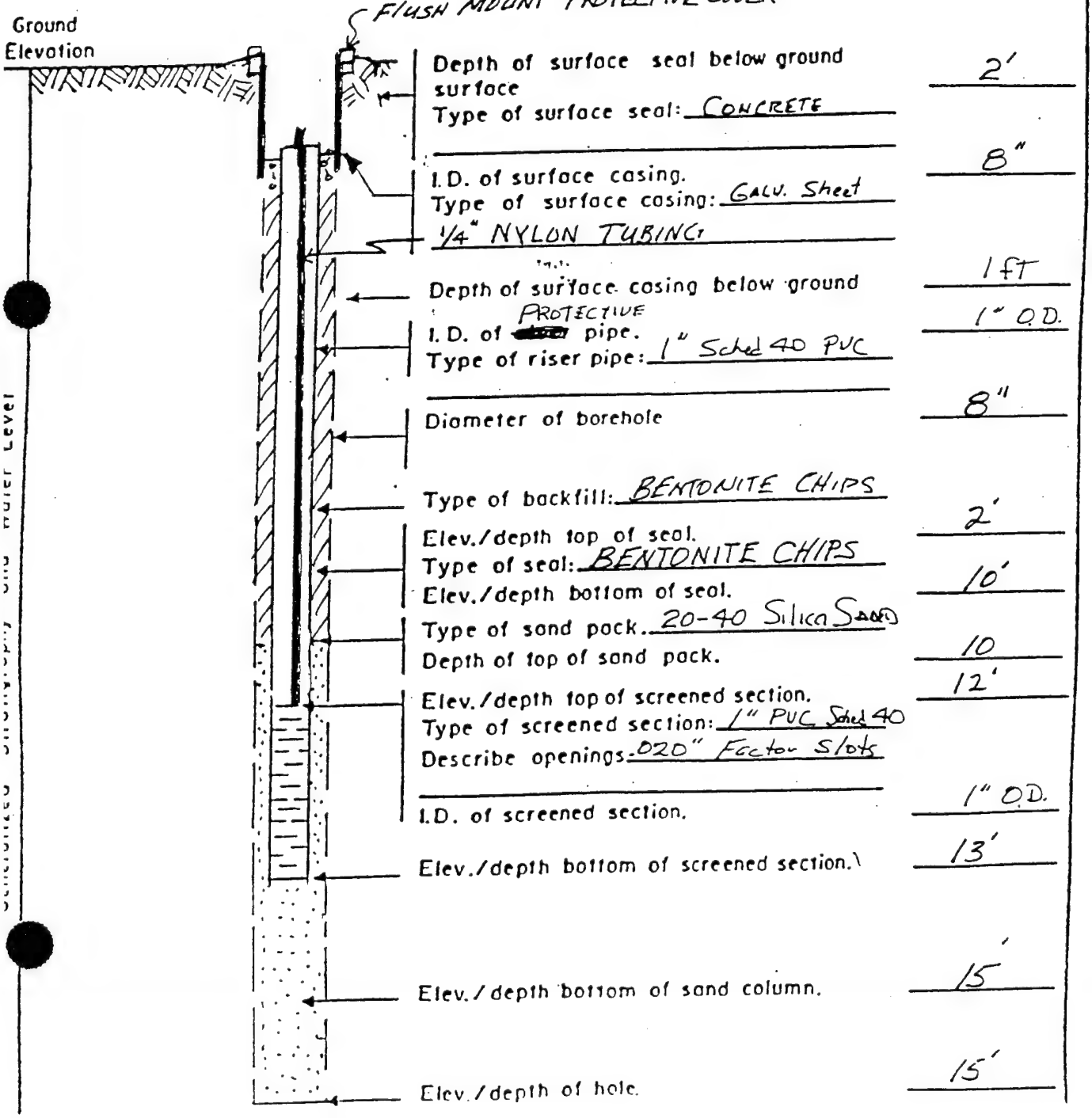


Elevation of top of ~~surface casing~~ / riser pipe.	
Height of top of ~~surface casing~~ / riser pipe above ground surface	20"
Depth of surface seal below ground surface	2
Type of surface seal: CONCRETE	
I.D. of surface casing. —	—
Type of surface casing:	
Depth of surface casing below ground	—
O.D. of riser pipe.	4"
Type of riser pipe: PVC Sched 40	
Diameter of borehole	10½"
Depth of borehole	60'
Type of backfill: GROUT	
Elev./depth top of seal.	35
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	40
Type of sand pack. 20-40 Silica	
Depth of top of sand pack.	40
Elev./depth top of screened section.	43
Type of screened section: Sched 40 PVC	
Describe openings: .020" FACTORY SLOTTED	
O.D. of screened section.	1"
Elev./depth bottom of screened section.	58'
Elev./depth bottom of sand column	60
Type of backfill below observation pipe. 20-40 Silica Sand	
Elev./depth of hole	60

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89 M 11461 (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/11/91 Original Depth 15'
Inspected By H. MERRELL Date 6/11/91
Checked By _____ Date _____

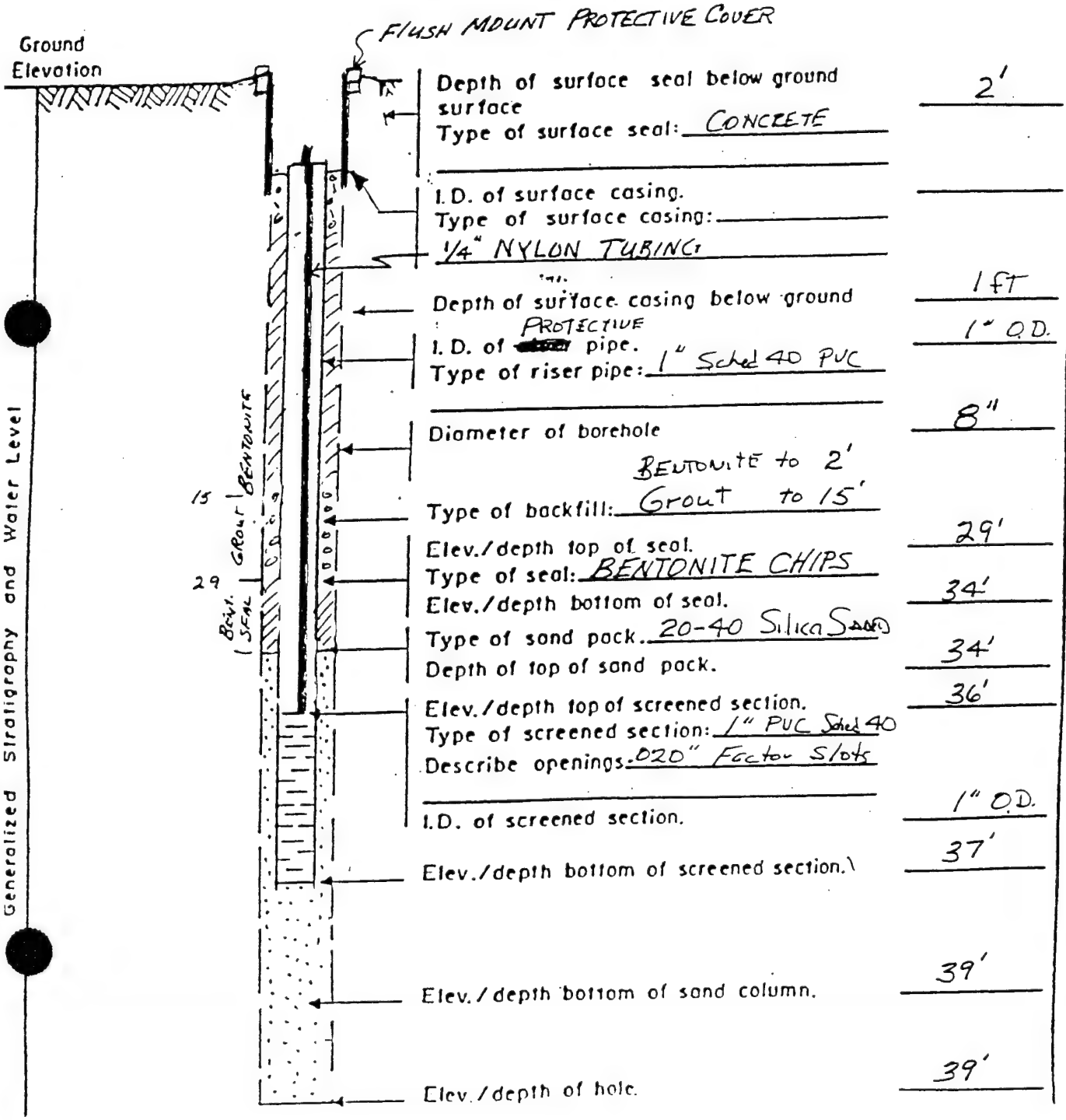
Page 1 of 1
Well No. VESP-5A
SCREEN
Depth Interval 12'–13'



OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M11461 (9948 wcFS)
LOCATION SECTION 4
Date Completed 6/10/91 Original Depth 39'
Inspected By H. MERRELL Date
Checked By 6/10/91 Date

Page 1 of 1
Well No. VESP-5B
SCREEN
Depth Interval 37'-36'



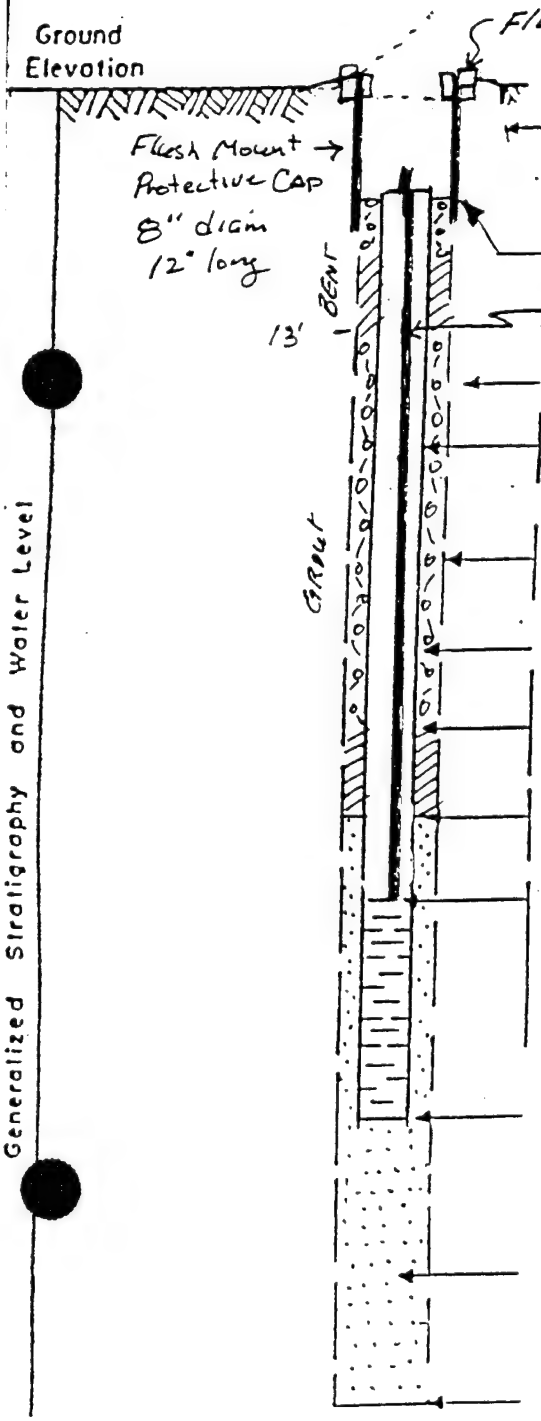
Depth of surface seal below ground surface	2'
Type of surface seal: CONCRETE	
I.D. of surface casing.	
Type of surface casing: 1/4" NYLON TUBING	
Depth of surface casing below ground	1ft
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: BENTONITE to 2' Grout to 15'	
Elev./depth top of seal.	29'
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	34'
Type of sand pack. 20-40 Silica Sand	
Depth of top of sand pack.	34'
Elev./depth top of screened section.	36'
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	37'
Elev./depth bottom of sand column.	39'
Elev./depth of hole.	39'

Generalized Stratigraphy and Water Level

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M114G1 (9948 WCFS)
LOCATION SECTION 4
Date Completed _____ Original Depth 55
Inspected By H. MERRELL Date _____
Checked By _____ Date _____

Page 1 of 1
Well No. VESP-5C
SCREEN Depth Interval 52'-53'

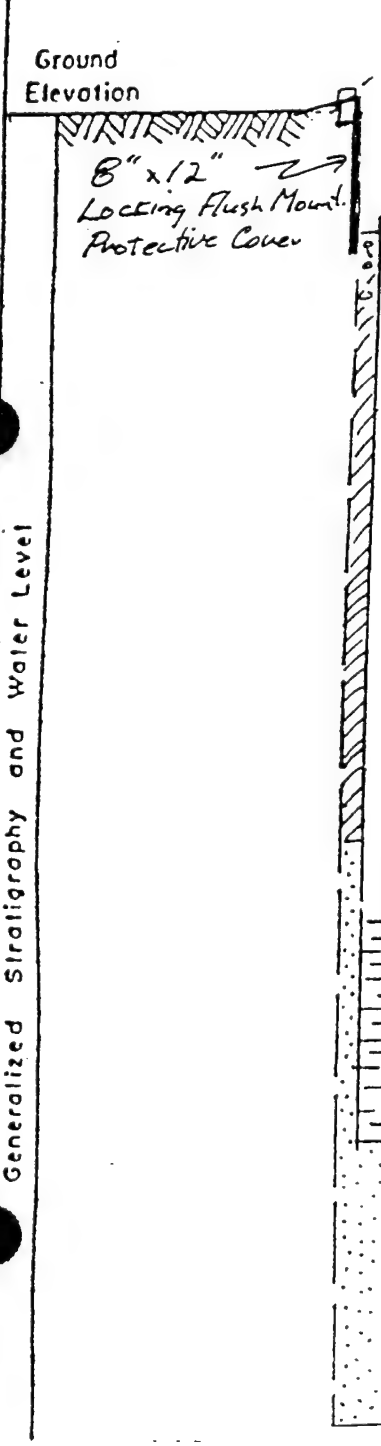


Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1 FT
I. D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: BENTONITE 13'-2' GROUT 44½-13'	
Elev./depth top of seal.	44½
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	50
Type of sand pack. 20-40 Silica Sand	
Depth of top of sand pack.	50
Elev./depth top of screened section.	52
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	53
Elev./depth bottom of sand column.	55
Elev./depth of hole.	55

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M114G1 (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/13/91 Original Depth
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-6A
SCREEN Depth Interval 13'-14'

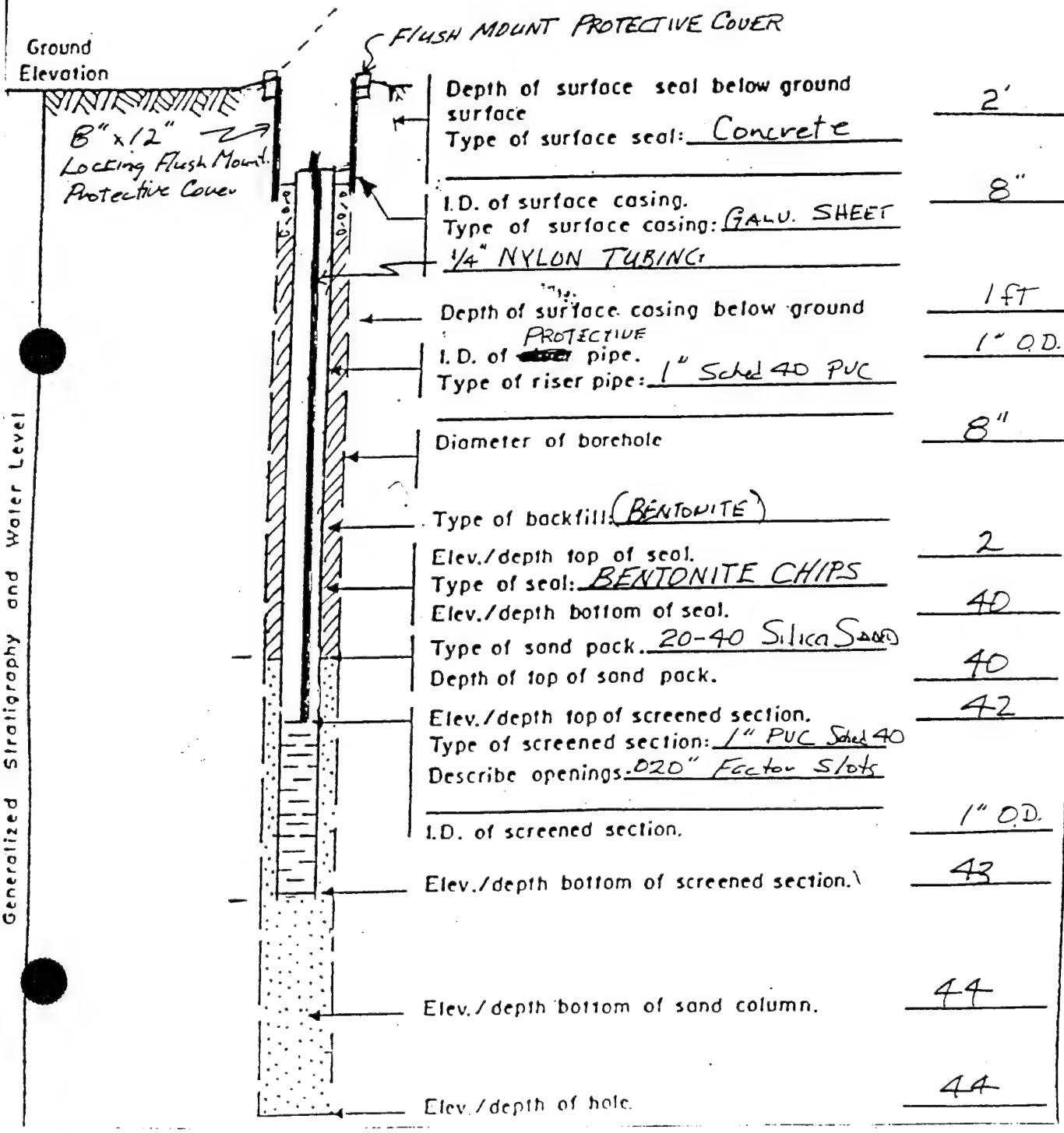


Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1 ft
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: (BENTONITE)	
Elev./depth top of seal.	2
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	11'
Type of sand pack: 20-40 Silica Sand	
Depth of top of sand pack.	11'
Elev./depth top of screened section.	13'
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	14'
Elev./depth bottom of sand column.	15'
Elev./depth of hole.	15'

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M114G1 (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/13/91 Original Depth 44
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-6B
SCREEN Depth Interval 42'-43'

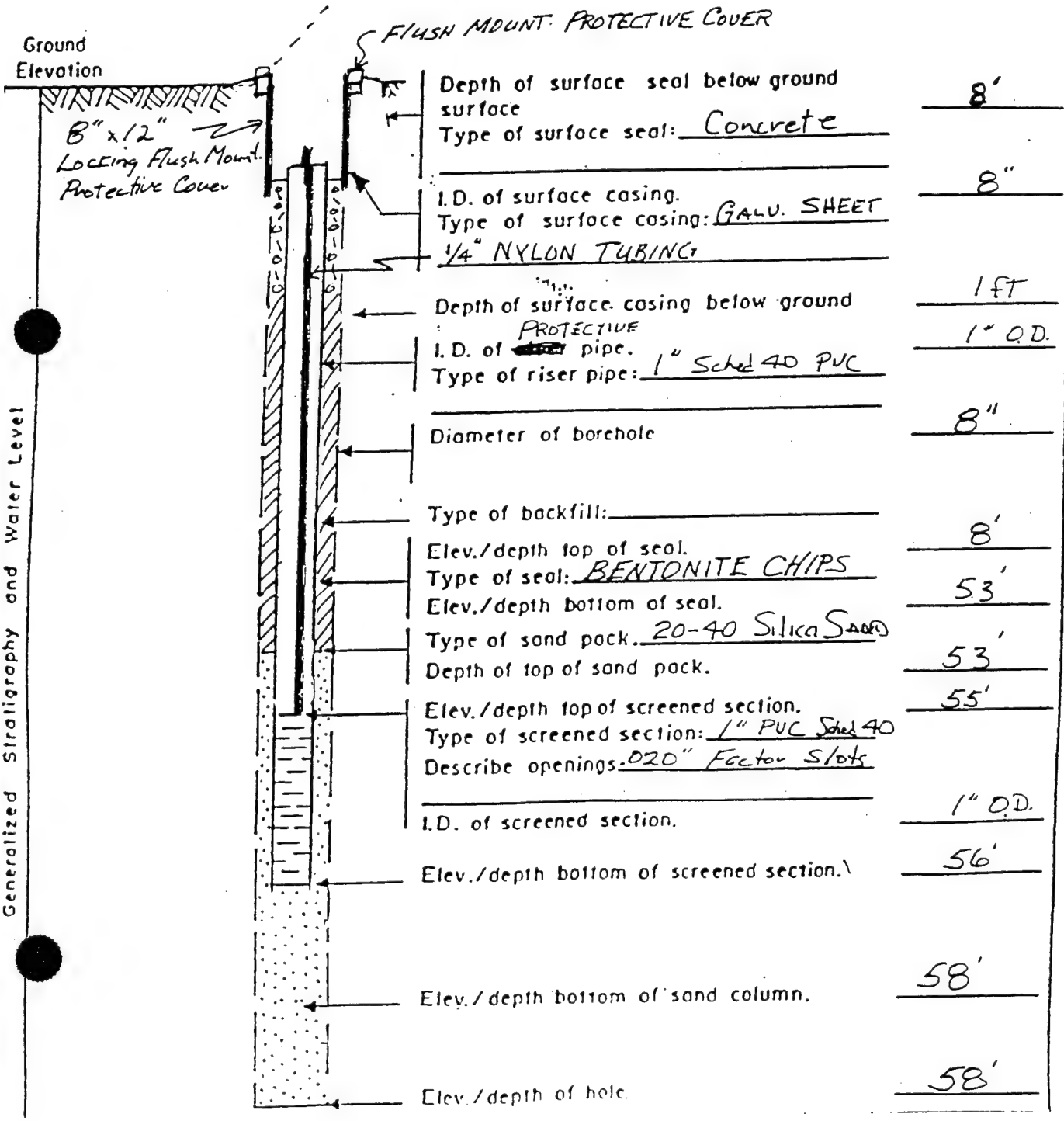


Depth of surface seal below ground surface: 2'
Type of surface seal: Concrete
I.D. of surface casing: 8"
Type of surface casing: GALV. SHEET
1/4" NYLON TUBING
Depth of surface casing below ground: 1 ft
I.D. of PROTECTIVE pipe: 1" O.D.
Type of riser pipe: 1" Sched 40 PVC
Diameter of borehole: 8"
Type of backfill: (BENTONITE)
Elev./depth top of seal: 2
Type of seal: BENTONITE CHIPS
Elev./depth bottom of seal: 40
Type of sand pack: 20-40 Silica Sand
Depth of top of sand pack: 40
Elev./depth top of screened section: 42
Type of screened section: 1" PVC Sched 40
Describe openings: .020" Factor Slots
I.D. of screened section: 1" O.D.
Elev./depth bottom of screened section: 43
Elev./depth bottom of sand column: 44
Elev./depth of hole: 44

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M114G1 (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/12/91 Original Depth 58'
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-6C
SCREEN
Depth Interval 55'-56'

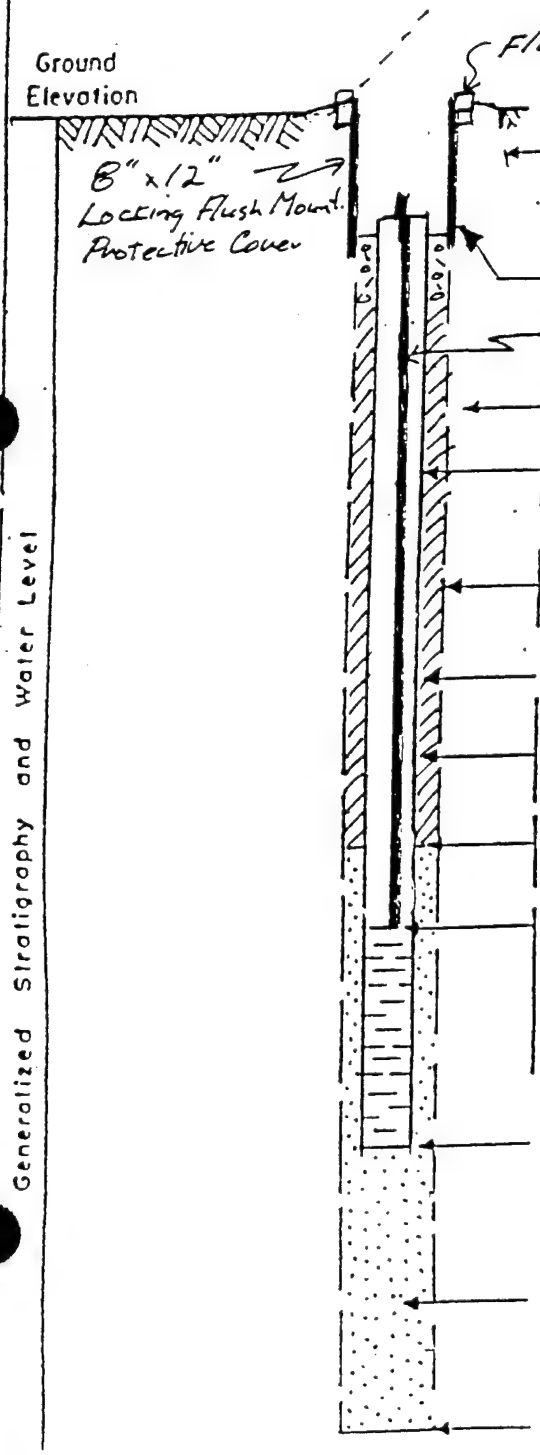


Depth of surface seal below ground surface	8'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1 ft
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill:	
Elev./depth top of seal.	8'
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	53'
Type of sand pack. 20-40 Silica Sand	
Depth of top of sand pack.	53'
Elev./depth top of screened section.	55'
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	56'
Elev./depth bottom of sand column.	58'
Elev./depth of hole.	58'

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M114G1 (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/12/91 Original Depth 15
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-7A
SCREEN Depth Interval 13'-14'

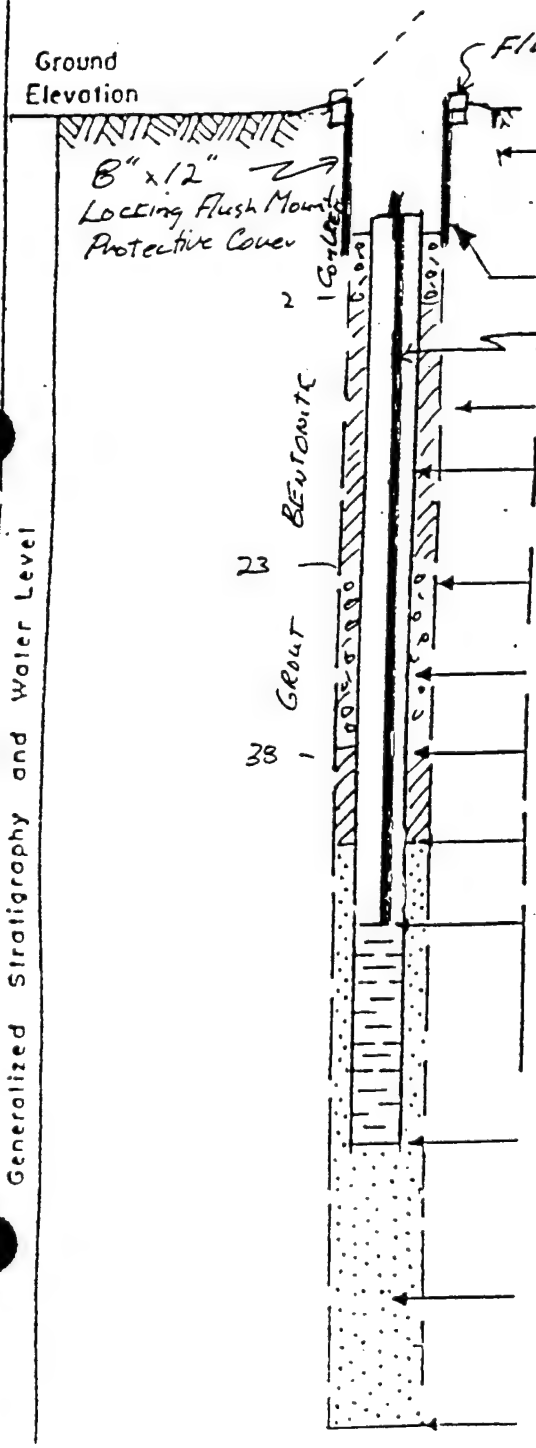


Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1 ft
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: —	
Elev./depth top of seal.	2'
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	10
Type of sand pack: 20-40 Silica Sand	
Depth of top of sand pack.	10
Elev./depth top of screened section.	12
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	13
Elev./depth bottom of sand column.	15
Elev./depth of hole.	15

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M114G1 (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/11/91 Original Depth 48
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-7B
SCREEN Depth Interval 45'-46'



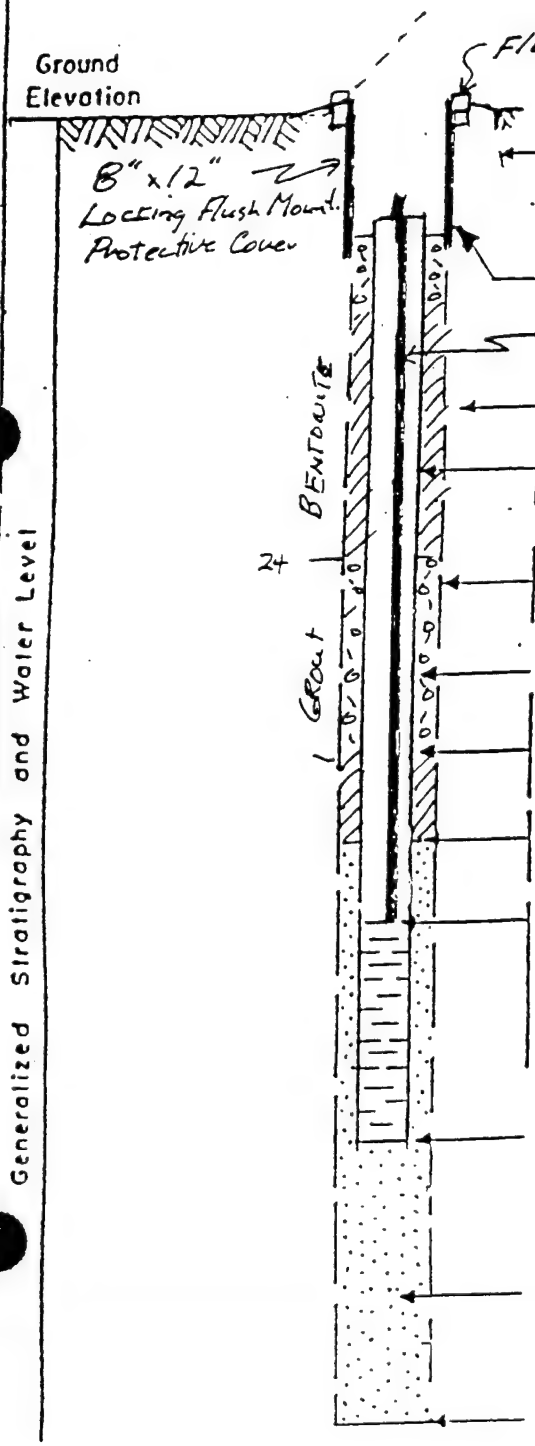
Generalized Stratigraphy and Water Level

Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1ft
I.D. of ~~protective~~ PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: BENT - 23-2' GROUT 38-23'	
Elev./depth top of seal.	38
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	43
Type of sand pack: 20-40 Silica Sand	
Depth of top of sand pack.	43
Elev./depth top of screened section.	45
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factory Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	46
Elev./depth bottom of sand column.	48
Elev./depth of hole	48

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M1146I (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/11/91 Original Depth 58
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-7C
SCREEN Depth Interval 56-55'



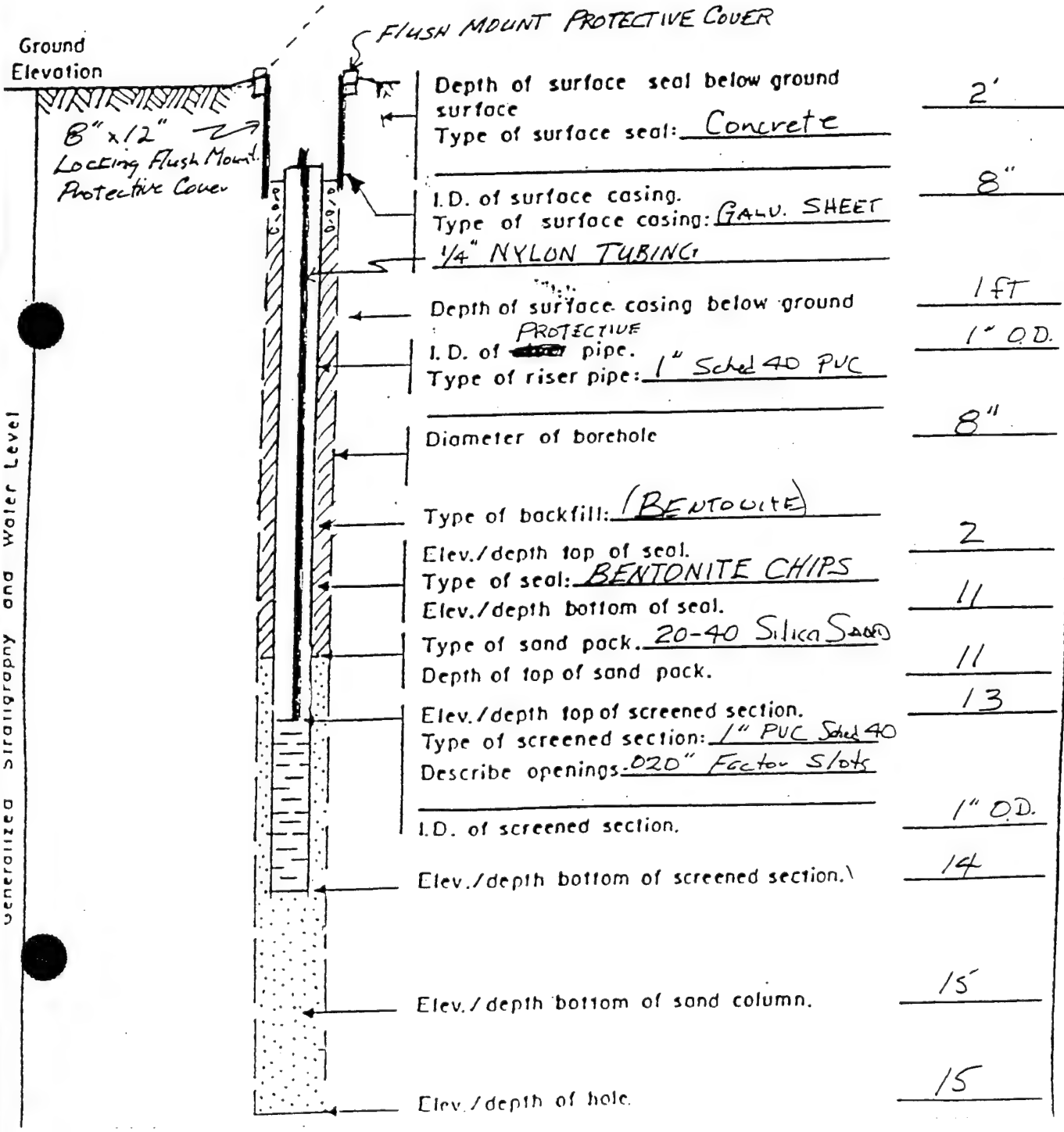
Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1FT
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: BENTOUITE 24-2 Grout 48-24	
Elev./depth top of seal.	48
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	53
Type of sand pack. 20-40 Silica Sand	
Depth of top of sand pack.	53
Elev./depth top of screened section.	55
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	56
Elev./depth bottom of sand column.	58
Elev./depth of hole.	58

Generalized Stratigraphy and Water Level

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M1146I (9948) WCFS
LOCATION SECTION 4
Date Completed 6/13/91 Original Depth 15
Inspected By H. MERRELL Date
Checked By Date

Well No. VESP-8A
SCREEN
Depth Interval 13'-14'

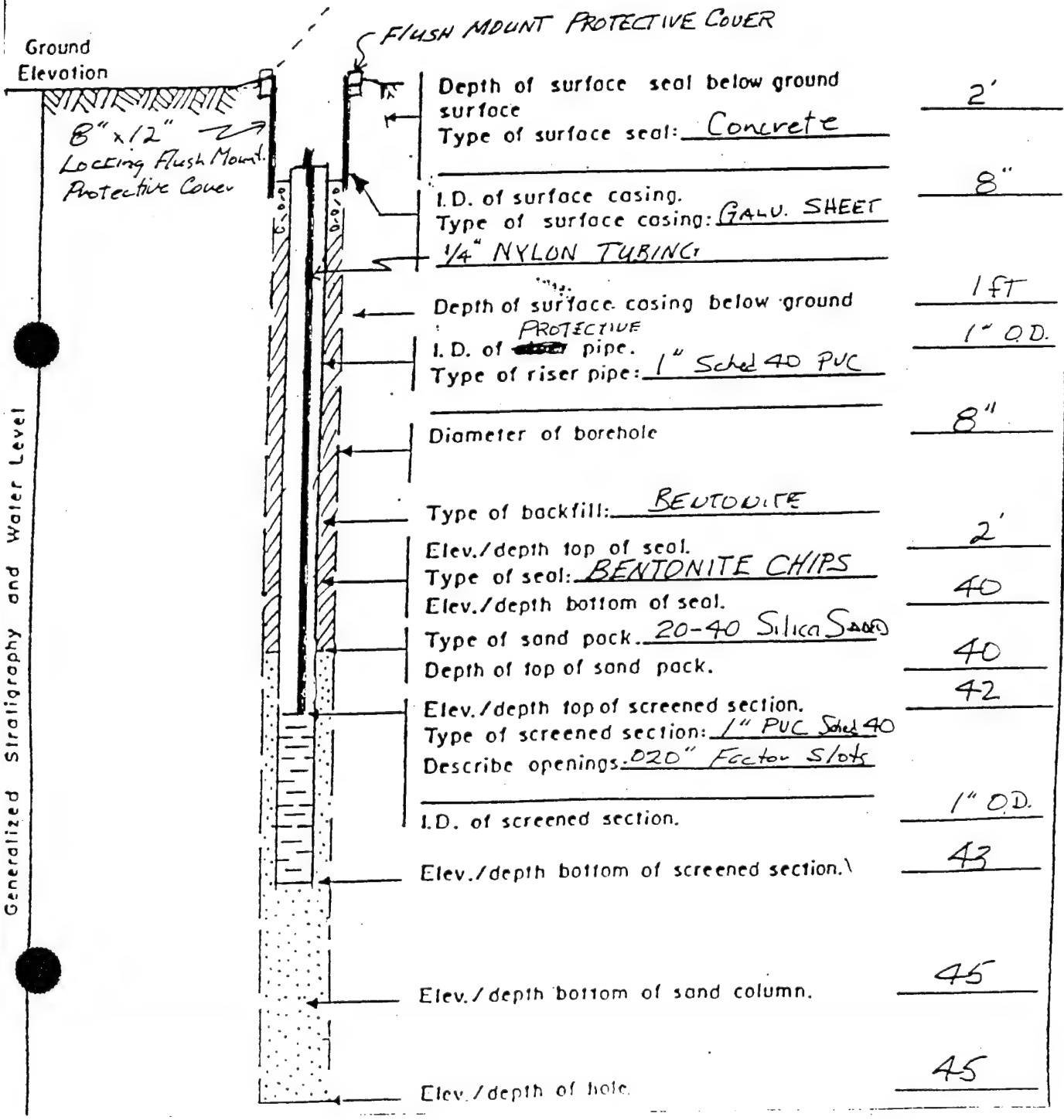


Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1 ft
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: (BENTONITE)	
Elev./depth top of seal.	2
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	11
Type of sand pack. 20-40 Silica Sand	
Depth of top of sand pack.	11
Elev./depth top of screened section.	13
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	14
Elev./depth bottom of sand column.	15
Elev./depth of hole.	15

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M114G1 (9948 WCFS)
LOCATION SECTION 4
Date Completed 6/13/91 Original Depth 45
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-8B
SCREEN Depth Interval 42'-43'

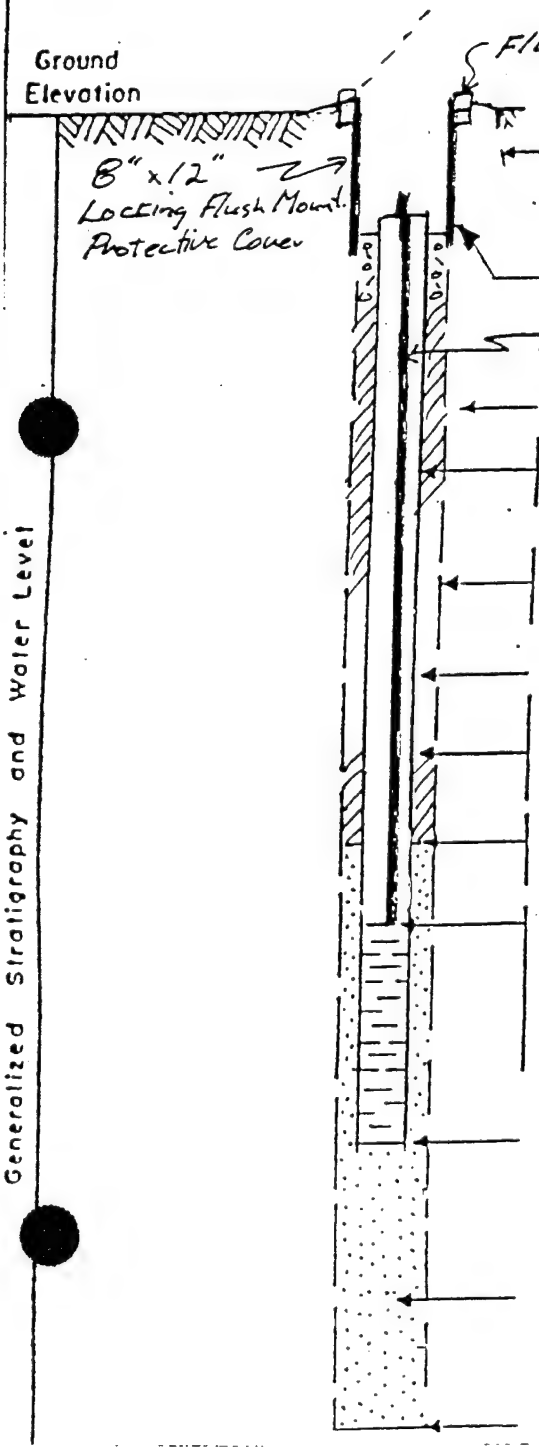


Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1 ft
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: BENTONITE	
Elev./depth top of seal.	2'
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	40
Type of sand pack. 20-40 Silica Sand	
Depth of top of sand pack.	40
Elev./depth top of screened section.	42
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factor Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	43
Elev./depth bottom of sand column.	45
Elev./depth of hole.	45

OBSERVATION WELL REPORT

PROJECT RMA COE MOTOR POOL VES 89M1146I (9948) WCFS
LOCATION SECTION 4
Date Completed 6/13/91 Original Depth 58
Inspected By H. MERRELL Date
Checked By Date

Page 1 of 1
Well No. VESP-8C
SCREEN
Depth Interval 55-56



Depth of surface seal below ground surface	2'
Type of surface seal: Concrete	
I.D. of surface casing.	8"
Type of surface casing: GALV. SHEET	
1/4" NYLON TUBING	
Depth of surface casing below ground	1 ft
I.D. of PROTECTIVE pipe.	1" O.D.
Type of riser pipe: 1" Sched 40 PVC	
Diameter of borehole	8"
Type of backfill: (BENTONITE)	
Elev./depth top of seal.	2
Type of seal: BENTONITE CHIPS	
Elev./depth bottom of seal.	53
Type of sand pack. 20-40 Silica Sand	
Depth of top of sand pack.	53
Elev./depth top of screened section.	55
Type of screened section: 1" PVC Sched 40	
Describe openings: .020" Factory Slots	
I.D. of screened section.	1" O.D.
Elev./depth bottom of screened section.	56
Elev./depth bottom of sand column.	58
Elev./depth of hole.	58

Woodward-Clyde Consultants PROJECT NAME COE MOTOR POOL VES HOLE NO. VESP-8

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE ENVIRONMENTAL	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/13/91 – 6/13/91
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH 15'	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" Sched 40 PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory Slots .020"	FROM 14 TO 13 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK 20-40 Silica Sand	FROM 15 TO 11 FT.		
TYPE OF SEAL BENTONITE CHIPS	FROM 11 TO 2 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./L	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	SAND, LT Yellow BRN (Munsell) 10YR 4/4 F-Mg, Sub A-Sub Rnd Sli Clayey, Moist. Poorly Graded SP								
2									
3									
4									
5									
6									
7									

PROJECT NO. 89M114G1 (was 9948)

SHEET 1 OF 2

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-8A

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7									
8									
9									
10	SAND LT Yellow BRN F-Cg Sub∠-Sub Rnd Poorly Sort, Moist								
11									
12	(SP)								
13									
14									
15	T.D								
16									

PROJECT NO. 89M1146I (9948) SHEET 2 OF 2

Woodward-Clyde Consultants PROJECT NAME COE MOTOR POOL VES HOLE NO. VESP-8

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE ENVIRONMENTAL	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/13/91 // 6/13/91
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH 45	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" Sched 40 PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory Slots .020"	FROM 44 TO 43 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK 20-40 Silica SAND	FROM 45 TO 40 FT.		
TYPE OF SEAL BENTONITE CHIPS	FROM 40 TO 1 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recovery	SAMPLES: Penetration Resist. (Blows/6 In)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	SAND LT Yellow BRN (Munsell) 10YR 4/4 F-Mg, Sub A - Sub Rd Moist, Poor GRADED Sli Clayey								
2									
3	(SP)								
4									
5									
6									
7									

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-8B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist (Blows/6 in)	REMARKS (Drill Rate, Field loss, Odor, etc.)
7	(SP)								
8									
9									
10	Sandy Light Yellow BROWN								
	F-C g, Sub R-Sub Rnd								
11	Moist, Poor Graded								
	(SP)								
12									
13									
14									
15									
16									

PROJECT NO. 89M114G1 (9948) SHEET 2 OF 6

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTORPOOL VES HOLE NO. VESP-8B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	Clayey Sand								
	Lt Yellow Brn								
17	(Munsell) 10YR 4/4								
	F-Cg								
	Poor Graded Moist								
18									
19									
20									
21									
	Tr Fine Gravel & Gnl								
22									
23									
24									
25									

PROJECT NO. 89M114G1 (9948) SHEET 3 OF 6

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTOR POOL VES HOLE NO. VESP-8B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
25	As Above								
26									
27	(SP)								
28									
29									
30									
31									
32									
33									
34									

PROJECT NO. 89M1146-1 (9948) SHEET 4 OF 6

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-8B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
35									
36									
37	Clayey Sand LT yellow BRN								
38	SP								
39									
40	Sandy Clay LT Yellow Brn								
	Fg 1% grit								
41									
	SC/CL								
42									
43									
44									

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTORPOOL VES HOLE NO. VESP-8B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist (Blows 6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
44	AS ABOVE	//							
45	T.D.								
46									
47									
8									
49									
50									
51									
52									
53									

PROJECT NO. 89M1141G1 (9948) SHEET 6 OF 6

Woodward-Clyde Consultants PROJECT NAME COE MOTOR POOL VES HOLE NO. VESP-8

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE ENVIRONMENTAL	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/13/91 - 6/19/91
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH 58'	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" Sched 40 PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory Slots .020"	FROM 56 TO 53 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK 20-40 Silica SAND	FROM 58 TO 53 FT.		
TYPE OF SEAL BENTONITE CHIPS	FROM 53 TO 2 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./L	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	SAND LT yellowish Brn (Munsell) 10YR 4/4 F-Mg, Sub ∠-Sub Rnd Moist, Poor Grded Sli clayey (SP)								
2									
3									
4									
5									
6									
7									

PROJECT NO. 89M114G1 (WCAS 9948) SHEET 1 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE MotorPool VES HOLE NO. VESP-8C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
7	(SP)								
8									
9									
10	SAND Lt Yellow BRN								
	F-Cg, Sub ∠-Sub Rnd								
11	Moist, Poor Graded								
	(SP)								
12									
13									
14									
15									
16									

PROJECT NO. 89M1146I (9948) SHEET 2 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTORPOOL VES HOLE NO. VESP-8C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetra. Resist Blows 6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	Clayey SAND LT Yellow BRN Munsell 10YR 4/4 F-Cg, Sub ∠ - Sub Rnd. Moist, Poorly Graded (SP)								
17									
18									
19									
20									
21	Lt Fine Gravel & Grit 1/8" – 1/4"								
22									
23									
24									
25									

PROJECT NO. 89M1146I (9948) SHEET 3 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTOR POOL VES HOLE NO. VESP-8C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
25	SAND As Above								
26									
27									
28									
29									
30									
31									
32									
33									
34									

PROJECT NO. 89M1146-1 (9948) SHEET 4 OF 7

Woodward-Clyde Consultants PROJECT NAME RMA COE MOTOR POOL VES HOLE NO. VESP-8C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
35	(SP)								
36									
37	Clayey SAND LT Yellow BRN (SP)								
38									
39									
40	Sandy, Clay LT Yellow BRN Fg, Sub A - Sub rnd 1% Gr. t. & Clay (SC/CL)								
41									
42									
43									
44									

PROJECT NO. 89M1146I (9948) SHEET 5 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTOR POOL VES HOLE NO. VESP-8C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Pene. Resist. Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
44	Sandy Clay A A-4								
	Lt Clay LT Yellow BRN								
45	Med plastic								
46	SAND Sli Clayey								
	Lt Yellow BRN								
	F-Cgl, Sub ∠ - SubRnd								
47	Poor Graded Moist -								
48									
49									
50									
51									
52									
53									

PROJECT NO. 89M1146I (9048) SHEET 6 OF 7

Woodward-Clyde Consultants PROJECT NAME PMACOE Motor Pool VES HOLE NO. VESP-8C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
53									
54									
55	Clayey SAND LT Yell. Brn F-Cg Sub A-Sub Rnd 10% Fines, Low plastic TR grit.								
56									
57	SP								
58	58' T.D								

PROJECT NO. 89M114G1 (994B) SHEET 1 OF 1

Woodward-Clyde Consultants PROJECT NAME RMA MOTOR POOL VES HOLE NO. VES-3

BORING LOCATION Sec 4 RMA		ELEVATION AND DATUM	
DRILLING AGENCY Layne Western	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/6/91 — 6/6/91
DRILLING EQUIPMENT CME 75 10½ OD		COMPLETION DEPTH 30	SAMPLER
DRILLING METHOD Hollow Stem	DRILL BIT 6¼ ID	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 4" PVC Sched 40		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION .020	FROM 28 TO 13 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK SAND 6-9	FROM 30 TO 11 FT.		
TYPE OF SEAL Bentonite	FROM 11 TO 5.5 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./ft.	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Field loss, Odor, etc.)
0	2 inch gravel 2" deep at Surface Gray Volc. (Ballast)								Gravel for RR Ballast
1	~~Clayey~~ Clayey Sand, F-Med grain, sl micaceous, Poor Graded, Sub-t Sand 90%, moist. Mensell 10 YR 3/4 dark yellowish Brown (SC)		SC						
2									
3									
4									
5	Clayey Sand GS cobble								
6									
7									

PROJECT NO. 9948 WCFS, (89M1146 wcc) SHEET 1 OF 4

Woodward-Clyde Consultants PROJECT NAME RMA Motor Pool SVE HOLE NO. VES-3

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7									
8									
9									
10	Clayey Sand, Dark yellow Brown Munsell 10YR 3/4, F-Mgr. Sub ℄-Sub rnd, Poor-Graded Slt micaceous, moist, clay ≈ 5% (SC)								
11									
12									
13									
14									
15									
16									

PROJECT NO. 9948(WCFS); 89M114G1

SHEET 2 OF 4

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTOR POOL VES HOLE NO. VES-3

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist. Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	Clayey SAND, LT yellowish Brown, Munsell 10YR 3/4 moist, F-Mg Sand, Sub A-Sub rnd, Sli micaceous (SC)								
17									
18									
19	Sli amount of 1/8"-1/4" grit. 1% ±								
20	Clayey Sand as above								
21									
22									
23	TR Clay balls 10YR 4/4 TR 1/4-1/8" grit								
24									
25									

PROJECT NO. 89M1146I (9948) SHEET 3 OF 4

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool #5 HOLE NO. VES-4

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
25	Clayey Sand Lt Yellow Brn 10YR 3/4 (Munsell) Moist, F-Mg Sand, Sub Rnded; TR fine grained Sub-rnd grit 1/4" & Fg grvl up to 1/2" (2-3%).								
26									
27									
28									
29									
30	T.D								Nothing above Background of 0-2 ppm on P.I.D.

PROJECT NO. 89M1146I (9948) SHEET 4 OF 4

Woodward-Clyde Consultants PROJECT NAME RMA Motor Pool VES HOLE NO. VES-4

BORING LOCATION Sec 4		ELEVATION AND DATUM	
DRILLING AGENCY Layne Western	DRILLER D. Werner	DATE STARTED / DATE FINISHED 6/7/91	
DRILLING EQUIPMENT CME 75	10½ OD	COMPLETION DEPTH 60	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 6¼ ID	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 4" PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory slot 020	FROM 58 TO 43 FT.	LOGGED BY	CHECKED BY
SIZE AND TYPE OF PACK Sand 6-9	FROM 60 TO 40 FT.		
TYPE OF SEAL Bentonite	FROM 40 TO 35 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./ft.	SAMPLES: Penetr. Resist. (Blow/6 in.)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
0	2" Volc. Gravel (R.P. Ballast)	SS							
	2" Soil BLK - DK GY								
1	Clayey Sand, DARK Yellow BRN Munsell 10YR 4/4								
2	F-Mg, Sub A - Sub Rd. Moist. Less than 5% fines. Non Plastic Clay material (SC)								
3									
4									
5	As Above w/ Clay incr. to ≈10%								
6	SLI MORE plastic								
7									

PROJECT NO. 9948 WCFS; (89M11461 WCC)

SHEET 1 OF 7

Woodward-Clyde Consultants PROJECT NAME RMA Motor Pool VES HOLE NO. VES-4

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist. Blows/6 in.	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
7									
8									
9									
10	Clayey Sand, DRK Yellow Brown (Munsell 10YR 4/4 Med - Coarse grained, Sub ∠ - Sub End, Very Sli amount of fines <5%								
11									
12	Moist (SC)								
13									
14									
15									
16									

PROJECT NO. 9948 89M1146I

Woodward-Clyde Consultants PROJECT NAME RMIS MOTOR POOL VES CORE HOLE NO. VES-4

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	Sand Med, Coarse Gr Sub ∠, SubRnd, Poor Sort. with 5% Fine Gravel 3/16 – 1/4" Sub rnded gr Poorly Sorted moist. (SP)								
17									
18									
19									
20	Sand DK ~~Red~~ Yellow BRN Munsell 10YR 4/4								
21	Sand, Med-Coarse gr Sub ∠ - Sub Rnd. 10% Fine gravel 1/8" – 1/2" - Sub rnd w/ Blk Staining around frags. No Odor, Moist. (SP)								
22									
23									
24									
25									

PROJECT NO. 9948 89M 114 G1 SHEET 3 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VES-4

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in.	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
25	Sand DK Yellow BRN C-VC grained, Sub Ang-Sub Rnd, Moist.; Fine Gravel 1/8 – 1/4" Sub Rnd. (20%) (SP)								
26									
27									
28									
29									
30									
31									
32									
33	Sand, DK BRN, F-Mgr Munsell 10YR 4/3, Moist 15% Fine Gravel 1/4-1/2"								Drlg Slowed at 33.
34									

PROJECT NO. 994B (WCFS) 89M114G1 SHEET 4 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VES-4

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
34	Sand DK BRN F-Mg moist, Sub ∠ - Sub Rnd 10% Gravel ¼-3/8 Rnd/Sub Rnd								
35									
36	Clayey Sand DK Yellow BRN Munsell 10YR 4/4 Silty Mixtures (SM/SC)(ML) fines ≈ 10-15%								
37									
38	Sand F-Mg-Cg with occasional ½" grit.								
39									
40	S Clayey Sand DK. Yell. BRN F-Mg, Sub ∠ - Sub Rnd								
41	few ⅓" grit grains								
42	(SC)/(ML)								
43									

PROJECT NO. 9948 (WLES) 89M114G1 SHEET 5 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VES-4

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetra. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
43									
44									
45	Clayey Silty SAND								
	Dk Yellow BRN.								
46	Munsell 10YR 4/4								
	F-C grained Sub End.								
	Moist.								
47	Fines = (10-15%)								
	F Gravel 1/8"-3/8" (20%)								
48	(SC)								
49									
50									
51									
52									

PROJECT NO. 9948 (WCFS) 89M1146I

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VES-4

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
52	Clayey Silty Sand DK Yellow BRN 10YR 4/4 (Munsell) F-Mg Sand Sub Rnd -Sub K. Moist. Little Fine Gravel 1/8 - 1/4" Sub Rnd.								
53									
54									
55									
56	(SC)								
57									
58									
59									
60	T.D 60'								

PROJECT NO. 9848 (WCFS) 89M114G1 SHEET 1 OF 1

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VESP-5A

BORING LOCATION Sec 4		ELEVATION AND DATUM	
DRILLING AGENCY Layne Environmental	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/11/91 — 6/11/91
DRILLING EQUIPMENT CME 75		COMPLETION DEPTH 15	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION 1" PVC Fact Slots .020"	FROM 13 TO 12 FT.	LOGGED BY H.W. MECREW	CHECKED BY
SIZE AND TYPE OF PACK Silica 20-40	FROM 15 TO 10 FT.		
TYPE OF SEAL Bentonite	FROM 10 TO 2 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./ft.	SAMPLES: Penetra. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	SAND, Clayey, LT Yellow Brn F-Mg, Sub Ang-Sub Rnd Sli Amount of Clay. Moist (SC)								
2									
3									
4									
5									
6									
7									

PROJECT NO. WCC 89M1146I (9948) SHEET 1 OF 2

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-5A

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7	AS ABOVE (SC)								
8									
9									
10	SAND, LT Yellow BRN, SUB ∠ - Sub Rnd, moist Poor Graded (SP)								
11									
12									
13									
14									
15	T.D.								

PROJECT NO. WCC 89M1141 (9948) SHEET 2 OF 2

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES ~~SVE~~ HOLE NO. VESP-SB

BORING LOCATION Sec 4 Motor Pool		ELEVATION AND DATUM	
DRILLING AGENCY Layne Environmental	DRILLER D. Werner	DATE STARTED 6/10/91 DATE FINISHED 6/10/91	
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 3 3/4 ID, HSA	NO. OF SAMPLES DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" PVC Sched 40		WATER ELEV. FIRST —	COMPL. 24 HRS.
TYPE OF PERFORATION Fact. Slots .020"	FROM 31 TO 36 FT.	LOGGED BY H.W. MERREW	CHECKED BY
SIZE AND TYPE OF PACK 20-40 Silica	FROM 39 TO 34 FT.		
TYPE OF SEAL Bentonite Med Chips	FROM 34 TO 29 FT.		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./L	SAMPLES: Penetra. Resist. (Blows/6 in.)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	Clayey Sand LT Yellow Brn								
2	Moist.								
	(SC)								
3									
4									
5									
6									
7									

PROJECT NO. WCC 89M114G1, WCES 9948

SHEET 1 OF 5

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VESP-5B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7									
8									
9									
10	Sand Sli Clayey								
11									
	(SP)								
12									
13									
14									
15									
16									

PROJECT NO. WCC 89M1146-1 (9948) SHEET 2 OF 5

VESP-5B

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. SP

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist. Blows (6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
16									
17									
18	Recon SM Clayey w/ Small occ. Cobbles								
19									
20	Sand lt Yellow BRN F-Mg, Sub A - Sub Rnd Moist								
21	SP								
22									
23									
24									
25									

PROJECT NO. WCC 89M1146I (9948) SHEET 3 OF 5

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-5B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetra. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
25	SAND LT Yellow BRN (Munsell) 10YR 4/4 F-Cg moist. Sub R-Sub Rnd. (SP)								
26									
27									
28									
29									
30									
31	CLAYEY, SILTY SAND LT Yellow BRN, Moist Sub R-Sub Rnd. (SC)/(ML)								
32									
33									
34									

PROJECT NO. 89M1146I (9948) SHEET 4 OF 5

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-5B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. (Blows 6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
34	Clayey Silty Sand								
	As Above								
35									
36									
37									
38									
39			T.D						

PROJECT NO. WCC 89M1146 1 (9948) SHEET 5 OF =

Woodward-Clyde Consultants PROJECT NAME MOTOR POOL AREA VEP COE HOLE NO. VESP-5C

BORING LOCATION Section 4 RMA		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE ENVIRONMENTAL	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/10/91 — 6/10/91
DRILLING EQUIPMENT CME 75		COMPLETION DEPTH	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Fact. Slots .020"	FROM 53 TO 52 FT.	LOGGED BY H. Merrell	CHECKED BY
SIZE AND TYPE OF PACK 20/40 Silica Snd	FROM 54½ TO 50 FT.		
TYPE OF SEAL Bentonite Chips	FROM 50 TO 44.5 FT.		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recovery	SAMPLES: Penetration Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
0	TRACE (2"±) Blk Soil & Ballast Gravel								
1	SAND, LT Yellow BRN, (Munsell) 10YR 4/4 F-Mg, Sub rnd-Sub ∠, moist. TR fines (SC)								
2									
3									
4									
5									
6									
7									

PROJECT NO. RMA COE 89MIAG1 (WCC); 9948 WCFS

SHEET 1 OF 7

VESP-5C

Woodward-Clyde Consultants PROJECT NAME _____ HOLE NO. ~~VESSC~~

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetra. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7	AS above								
8	SC								
9									
10	SAND LT YELLOW BRN (Munsell) 10YR 6/4 F-Mg, Subrnd-Sub & Moist, Poorly graded								
11									
12									
13									
14									
15									
16									

PROJECT NO. 89M11461 (9948) SHEET 2 OF 2

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VESP-5C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetra. Resist (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	Clayey Sand at Yellow Base Munsell 10YR 4/4 F-Mg, Poor Graded Moist. Sub Ang - Sub Rnd.								
17									
18									
19									
20									
21									
22									
23									
24									
25									

PROJECT NO. B9M114G1 (9948) SHEET 3 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VESP-5C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
25	As Above								
26									
27									
28									
29									
30									
31									
32	Clayey Sand, LT Yellow BRN Sub Rnd/Sub Ang, Fg, Very Clayey w. 42 SLT.								
33									
34	(SC) ~~SP~~ (ML)								

PROJECT NO. 89M114G1 (9948)

SHEET 4 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACDE Motor Pool VES HOLE NO. VESP-5C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist. (Blows/6 in.)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
34									
35	Clayey Sand LT Yellow BRN Moist Munsell 10YR-4/4 M-Mg Sand, SUB & Sub RND								
36	TR BLK Clay < 1% (SC)/(ML)								
37									
38									
39									
40	SAND LT Yellow BRN F-Mg Sub & - Sub RND								
41	Mois Poorly Graded (SP)								
42									
43									

PROJECT NO. 89M114G1 (9948) SHEET 5 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VESP-5C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
43	Sand AS ABOVE (SP)								
44									
45	~~Sand~~ Clayey Sand, LT Yell. Brn F-Mg								
46									
47									
48									
49									
50	SAND F-Mg Moist Sub Δ, Sub Rnd. (SP)								
51									
52									

PROJECT NO. 89M114G1 (9948) SHEET 6 OF 7

Woodward-Clyde Consultants PROJECT NAME PMACOE MOTOR POOL VES HOLE NO. VESP-5C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
52	SAND AS ABOVE (SP)								
53									
54									
55									

PROJECT NO. 89M114G1 (9948) SHEET 1 OF 1

Woodward-Clyde Consultants PROJECT NAME COE MOTOR POOL VES HOLE NO. VESP-6A

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE ENVIRONMENTAL	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/13/91 — 6/13/91
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH 15'	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" Sched 40 PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory Slots .020"	FROM 14 TO 13 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK 20-40 Silica SAND	FROM 15 TO 11 FT.		
TYPE OF SEAL BENTONITE CHIPS	FROM 11 TO 01 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./ft.	SAMPLES: Penetra. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	SAND, Sli Clayey LT Yellow Brn (Munsell) 10YR 4/4 F-Mg, Sub A-Sub R ND Moist, POORLY GRADED (SP)								
2									
3									
4									
5									
6									
7									

PROJECT NO. 89M114G1 (WCAS 9948)

SHEET 1 OF 2

Woodward-Clyde Consultants PROJECT NAME RMA COE MOTOR POOL VES HOLE NO. VESP-6A

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7									
8									
9									
10	SAND								
	AS ABOVE								
11	Fines decr.								
12									
13									
14									
15	15' T.D.								
16									

PROJECT NO. 89M1146I (9948)

SHEET 2 OF 2

Woodward-Clyde Consultants PROJECT NAME COE MOTOR POOL VES HOLE NO. VESP-61

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE ENVIRONMENTAL	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/12/91 – 6/13/91
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH 44	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" Sched 40 PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory Slots .020"	FROM 43 TO 42 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK 20-40 Silica SAND	FROM 44 TO 40 FT.		
TYPE OF SEAL BENTONITE CHIPS	FROM 40 TO 2 FT.		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recovery	SAMPLES: Penetration Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	SAND SLi Clayey LT yellow BRN (Munsell) 10YR 4/4 F-Mg, Sub A-Sub Rd Moist, Poor Graded								
2									
	(SP)								
3									
4									
5									
6									
7									

PROJECT NO. 89M114G1 (WCCS 9948)

SHEET 1 OF 5

Woodward-Clyde Consultants PROJECT NAME RMACOE Motor Pool VES HOLE NO. VESP-6B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetra. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7	As Above								
8									
9									
10									
11									
12									
13									
14									
15									
16									

PROJECT NO. 89M1146I (9948)

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTORPOOL VES HOLE NO. VESP-6B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16									
17									
18									
19									
20	SAND, Gravely LT Yellow BRN (Munsell) 10YR 4/4 F-Mg — TR 1/8" Gravel F-Mg — Sub ∠ Moist, POORLY GRADED (SP)								
21									
22									
23									
24									
25									

PROJECT NO. 89M114G1 (9948) SHEET 3 OF 5

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTOR POOL VES HOLE NO. VESP-6B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetra. Resist Blows 6 in)	REMARKS (Drill Rate, Field loss, Odor, etc)
25									
26	(SP)								
27									
28									
29									
30	SAND LT Yellow BRN F-Cg, SG 4-SG Rnd Moist, Poorly Graded To 1/4" Gravel								
31									
32	(SP)								
33									
34									

PROJECT NO. 89M1146-1 (9948) SHEET 4 OF 5

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-6B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetra. Resist. Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
35	SAND LT Yellow BRN F-Mg, Sub ∠-Sub R. Moist Poorly Graded								
36									
37	SP								
38									
39									
40	Sandy, SLTY Clay, LT Yellow BRN (Munsell) 10YR 4/4 Med Plastic, Moist (CL/ML)								
41									
42									
43									
44	44' TD								

PROJECT NO. 89M114G1 (9948) SHEET 5 OF 5

Woodward-Clyde Consultants PROJECT NAME COE MOTOR POOL VES HOLE NO. VESP-6

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE ENVIRONMENTAL	DRILLER D. WERNER	DATE STARTED / DATE FINISHED	6/12/91 — 6/12/91
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH 58'	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" Sched 40 PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory Slots .020"	FROM 56 TO 55 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK 20-40 Silica SAND	FROM 58 TO 53 FT.		
TYPE OF SEAL BENTONITE CHIPS	FROM 53 TO 1 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./L	SAMPLES: Penetr. Resist. (Blows/6 in.)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
0	2" Gravel (R.R. Ballast)								
1	SAND, Sli amounts of fines F-Mg, Sub ✱ - Sub Rnd Moist Poorly Graded TR Clay ≤ 2% ? LT Yellow BEN (Munsell) 10YR 4/4 (SP)								
2									
3									
4									
5									
6									
7									

PROJECT NO. 89M114G1 (WCCS 9948)

SHEET 1 OF 7

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-6C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetra. Resist (Blows 6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
7	AS ABOVE								
8									
9									
10	Sand As Above Fines decr. to nil								
11	(SP)								
12									
13									
14									
15									
16									

PROJECT NO. 89M114G1 (9948) SHEET 2 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE MotorPool VES HOLE NO. VESP-6C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	SAN LT Yellow Brn								
	F-Mg, Sub ∠-Sub Rnd								
17	Moist, Poor Graded								
18	Te 3/8" gravel Sub Rnd								
19									
20	Gravelly Sand LT Yellow Brn								
	F-Cg, Sub ∠-Sub Rnd								
21	Poorly Graded, Moist								
	(SP)								
22									
23									
24									
25									

PROJECT NO. 89M14G1 (9948)

SHEET 3 OF 7

Woodward-Clyde Consultants PROJECT NAME PMACOE Motor Pool VES HOLE NO. VESP-6C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
25	Gravely Sand								
	As Above								
26	Gravel 10% ±								
27									
28									
29									
30	Gravel size inch to maximum 1/2" x 3/4"								
31									
32									
33									
34									

PROJECT NO. 89M1146-1 (9948) SHEET 4 OF 7

Woodward-Clyde Consultants PROJECT NAME RMA COE MOTOR POOL VES HOLE NO. VESP-6C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
35									
36									
37	SAND · Clayey								
38									
39									
40	~~Clayey~~ Sandy, Clay & ~~F=A~~ SLT. Sli Plastic, Sand Fg, TR gravel 1/8" (CL/ML)								
41									
42									
43									
44									

PROJECT NO. 89M114G1 (9948) SHEET 5 OF 7

Woodward-Clyde Consultants PROJECT NAME RMACOE MOTOR POOL VES HOLE NO. VESP-6C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
44									
45	As Above w/ few 1" gravel, Rnded & 1/8" gravel. Clay Content decr.								
46	TC DK GY - BLK ~~SH~~ Cly Balls Moist (SP)								
47									
48									
49									
50	SAND F-Cg Sub ℄-Sub Rnd								
51									
52									
53									

PROJECT NO. 89M1141G1 (9948) SHEET 6 OF 7

Woodward-Clyde Consultants PROJECT NAME PMACOE Motor Pool VES HOLE NO. VESP-6C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
53	SAND, Clayey Lt Yellow Brn F-Cg Subrd - Sub Rnd Moist. Poor Graded (SP)								
54									
55									
56									
57									
58	T.D. 58'								

PROJECT NO. 89M114GL (9948) SHEET 1 OF 1

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-7A

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY Layne Environmental	DRILLER D. WERNER	DATE STARTED / DATE FINISHED 6/12/91 — 6/12/91	
DRILLING EQUIPMENT CME 75		COMPLETION DEPTH 15'	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" Sched 40 PVC		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION .020" 1" PVC Factory Slots	FROM 13 TO 12 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK 20/40 Silica Sand	FROM 15 TO 10 FT.		
TYPE OF SEAL Bentonite Chips	FROM 10 TO 1 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./ft	SAMPLES: Penetr. Resist. (Blow/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
0	2" Blk Soil / SH								
1	SAND, Clayey, Lt Yellow Brn Munsell 10YR 4/4 F-Mgr., Sub A-Sub Rnd Moist, Poorly Graded Fines ≈ 5% (SP)								
2									
3									
4									
5									
6									
7									

Woodward-Clyde Consultants PROJECT NAME RMA COE MOTOR POOL VES HOLE NO. VESP-7A

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist. Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7	SAND As Above								
8	(SP)								
9									
10	SAND LT Yellow BRN F-Mg Sub ∠-Sub Rnd Poor Graded - Moist SP								
11									
12									
13									
14									
15	15' T.D.								

PROJECT NO. 89M1146I (9948) SHEET 2 OF 2

Woodward-Clyde Consultants PROJECT NAME POACOE Motor Pool VES HOLE NO. VESP-7

BORING LOCATION Sec 4		ELEVATION AND DATUM	
DRILLING AGENCY Layne Environmental	DRILLER D. Werra	DATE STARTED / DATE FINISHED	6/11/91 – 6/11/91
DRILLING EQUIPMENT CME-75		COMPLETION DEPTH 48	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" PVC Sched 40		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION Factory Slots .020	FROM 46 TO 45 FT.	LOGGED BY H. Merrell	CHECKED BY
SIZE AND TYPE OF PACK #20-40 Silica	FROM 48 TO 43 FT.		
TYPE OF SEAL Bentonite Chips	FROM 43 TO 38 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./ft.	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	SAND, Clayey, Lt Yellow Brn (Munsell) 10YR 4/4 F-Mg, Sub ← – Sub Rnd Poor Graded, Moist Trace fines, non-plastic (SP)								
2									
3									
4									
5									
6									
7									

PROJECT NO. WCC 89M1146I (9948) SHEET 1 OF 6

Woodward-Clyde Consultants PROJECT NAME RMA COE MotorPool VES HOLE NO. VESP-7B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist. Blows/6 in.	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
7	As Above								
8	(SP)								
9									
10	SAND LT-Yellow Brn								
	F-Mg Subrd-Subrnd								
11	Fines decr.								
12	(SP)								
13									
14									
15									
16									

PROJECT NO. WCC 89M1146I (9948) SHEET 2 OF 6

Woodward-Clyde Consultants PROJECT NAME RMA Motor Pool VES HOLE NO. VESP-7B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetra. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	SAND LT Yellow BRN								
17	M-Cg, Sub A-Sub Rnd								
	Moist Poor Sort.								
	Trace Grit 1/8-1/4"								
18	(1-2%)								
	TR Fines								
	(SP)								
19									
20									
21									
22									
23									
24									
25									

PROJECT NO. 89M114G1 (9948) SHEET 3 OF 6

Woodward-Clyde Consultants PROJECT NAME RMA Motor Pool VES HOLE NO. VESP-78

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
25	SAND LT yellow BRN M-Cg, Sub Rnd Moist								
26	Some Grit 1/8"-1/4" 10% Sub Rnd								
27	(SP)								
28									
29									
30	As above Gravel incr to 15% & 1/8"-1/2" Moist Poor Sort								
31									
32	(SP)								
33									
34									

PROJECT NO. 89M11461 (9948) SHEET 4 OF 6

Woodward-Clyde Consultants PROJECT NAME RMA Motor Pool VES HOLE NO. VESP-7B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in.	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
34	SAND, Gravelly LT Yellow BRO Poor GRADED. Moist M-Cg, Sub A – Sub Rnd. 20% Fine Gravel & Grit								
35									
36									
37									
38									
39									
40	SAND, clayey LT Yellow BRO F-Mg Sub A Moist, Poor Graded (SP)								
41									
42									
43									

PROJECT NO. 89M1146I (9948) SHEET 5 OF 6

Woodward-Clyde Consultants PROJECT NAME RMA Motorpool VES HOLE NO. VESP-7B

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
43	As Above								
44	(SP)								
45	SAND & CLAY Lt Yellow BRN F-Mg Low Plastic, Moist								
46	CL/SP								
47									
48	T.D								

PROJECT NO. 89M1146I (9948) SHEET 6 OF 6

Woodward-Clyde Consultants PROJECT NAME RMACOE Mitar Pod 3 VES HOLE NO. VESP-7C

BORING LOCATION SEC 4		ELEVATION AND DATUM	
DRILLING AGENCY LAYNE Environmental	DRILLER D. WERNER	DATE STARTED / DATE FINISHED 6/11/91 –	
DRILLING EQUIPMENT CME 75		COMPLETION DEPTH 58	SAMPLER
DRILLING METHOD Hollow Stem Auger	DRILL BIT 8"	NO. OF SAMPLES / DIST.	UNDIST.
SIZE AND TYPE OF CASING 1" PVC Sched 40		WATER ELEV. / FIRST	COMPL. / 24 HRS.
TYPE OF PERFORATION PVC Sched 40, 1"	FROM 56 TO 55 FT.	LOGGED BY H.W. MERRELL	CHECKED BY
SIZE AND TYPE OF PACK Silica 20-40	FROM 58 TO 53 FT.		
TYPE OF SEAL Bentonite Chips	FROM 53 TO 48 FT		

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov./L	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
1	Clayey Sand, Lt Yellow Brn (Munsell) 10YR 4/4 F-Mg, Sub & - Sub Rnd Most, non-plastic Poorly Graded, Moist								
2									
3	~~(SC)~~ ~~SC~~								
4	SP								
5									
6									
7									

PROJECT NO. WCC-89M114-G1 (9948) SHEET 1 OF 7

Woodward-Clyde Consultants PROJECT NAME Motor Pool VES HOLE NO. VESP7C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist. (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
7	Clayey Sand As Above								
8	SP								
9									
10	SAND, SLI Clayey LT Yellow BRN. F-C g. (few 1/8" grains) Subang - Subrnd Clay & Fines Reduced To TRACE Poorly Graded, moist (SP)								
11									
12									
13									
14									
15									
16									

PROJECT NO. 89M114G1 (9948) SHEET 2 OF 7

Woodward-Clyde Consultants PROJECT NAME Motor Pool VES HOLE NO. VESP-7C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows/6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
16	SAND AS ABOVE								
17	SC/SP								
18	"								
19									
20	SAND LT Yellow BRN (Munsell) 10YR 4/4								
21	F-C g 5% Fine Gravel (Grit) 1/8-1/4"								
22	Moist Poor Graded (SP)								
23									
24									
25									

PROJECT NO. WCC 89M114G1 (9948) SHEET 3 OF 7

Woodward-Clyde Consultants PROJECT NAME Motor Pool VES HOLE NO. VESP-7C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetra. Resist. Blows 6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc)
25	SAND AS ABOVE								
26	(SP)								
27									
28									
29									
30									
31	SAND, ~~Clayey~~ Sli Clayey Lt Yellow Brn Moist, Poor Graded								
32	F Mg., TR Grit size (SP)								
33									
34									

PROJECT NO. 89M1161 (9948) SHEET 4 OF 7

Woodward-Clyde Consultants PROJECT NAME Motor Pool VES HOLE NO. VESP-7C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. (ft)	SAMPLES: Penetr. Resist (Blows/6 in)	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
34									
35	SAND, Sli Clayey LT Yellow BRN, F-Mg, Sub A-Sub R. Non Plastic, Moist LT Grit + Sand grains SP								
36									
37									
38									
39									
40									
41	Sand LT Yellow Brn M-Cg, Sub A-Sub Rnd, Moist & Clay, Plastic, Moist Color 10YR 4/4								
42									
43									

PROJECT NO. 89M11461 (9948) SHEET 5 OF 7

Woodward-Clyde Consultants PROJECT NAME RMA COE / Motor Pool VES HOLE NO. VESP-7C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Penetr. Resist Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc.)
43	SAND & CLAY as above								
44									
45									
46	CLAY soft, sli plastic, moist; some sand & silt - 30% (CL)								
47									
48									
49									
50	SAND LT Yellow Brn F-Mg MOIST TR Gelt sized gr. Clayey (SP)								
51									
52									

PROJECT NO. 89411461 (9948) SHEET 6 OF 7

Woodward-Clyde Consultants PROJECT NAME RMA COE Motor Pool VES HOLE NO. VESP-7C

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG: Lithology	GRAPHIC LOG: Piezometer Installation	Water Content	Piezometer Data	SAMPLES: Type No.	SAMPLES: Recov. ft	SAMPLES: Pen. & Resist. Blows 6 in	REMARKS (Drill Rate, Fluid loss, Odor, etc)
52	SAND LT Yellow Brown Munsell 10YR 4/4 F-M-grained, Sub ₺, Sub RND Moist, Poor Graded TR Fines (SP)								
53									
54									
55									
56									
57									
58	T.D 58'								

APPENDIX B
ANALYTICAL CHEMISTRY RESULTS

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARP-AL
Page 1 of 3
Part 1 of 1

Date 7/29/91
Agency Identification Number 91-1959
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Standford Place 3, Suite 1000
Denver, CO 80237
Attention: Jeff Cox

FAX
Telephone (303) 740-2791

Sampling Collection and Shipment

Sampling Site _____ Date of Collection July 16, 1991

Date Samples Received at DataChem July 22, 1991

Analysis

Method of Analysis GC/FID

Date(s) of Analysis July 24, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample 'A' SECTION	Trichloroethylene mg/sample 'B' SECTION
VESP5A071691	CL 14995	CT	0.06	ND*
VESP5B071691	CL 14996	CT	0.14	ND*
VESP5C071691	CL 14997	CT	0.16	ND*
VESP6A071691	CL 14998	CT	0.13	ND*
VESP6B071691	CL 14999	CT	0.17	ND*
VESP6C071691	CL 15000	CT	0.12	ND*
VESP7A071691	CL 15001	CT	0.23	ND*
VESP7B071691	CL 15002	CT	0.21	ND*
VESP7C071691	CL 15003	CT	0.17	ND*
VESP8A071691	CL 15004	CT	0.09	ND*
VESP8B071691	CL 15005	CT	0.09	ND*
VESP8C071691	CL 15006	CT	0.02	ND*
VES-1000-P	CL 15007	CT	0.22	ND*

* See comment on last page.
ND Parameter not detected.
'R Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Amy Jo Johnson

Reviewer: Pamela Johnson

Laboratory Supervisor: Daniel J. Bruch

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 3
Part 1 of 1

Date 7/29/91
Agency Identification Number 91-1959

Analytical Results

Field Sample Number	Batch/Lab Number	Sample Type	Trichloroethylene mg/sample 'A' SECTION	Trichloroethylene mg/sample 'B' SECTION							
VES-1001	CL 15008	CT	ND*	ND*							
VESP5A071791	CL 15009	CT	0.22	ND*							
VESP5B071791	CL 15010	CT	0.06	ND*							
VESP5C071791	CL 15011	CT	ND*	ND*							
VESP6A071791	CL 15012	CT	0.11	ND*							
VESP6B071791	CL 15013	CT	0.06	ND*							
VESP6C071791	CL 15014	CT	ND*	ND*							
VESP7A071791	CL 15015	CT	0.07	ND*							
VESP7B071791	CL 15016	CT	0.10	ND*							
VESP7C071791	CL 15017	CT	ND*	ND*							
VESP8A071791	CL 15018	CT	0.02	ND*							
VESP8B071791	CL 15019	CT	0.02	ND*							
VESP8C071791	CL 15020	CT	0.01	ND*							
VES-3-071791	CL 15021	CT	0.25	ND*							
VBSDIS071791	CL 15022	CT	ND*	ND*							
VES-1002-P	CL 15023	CT	0.26	ND*							
VES-1003	CL 15024	CT	ND*	ND*							
VESP5A071991	CL 15025	CT	0.05	ND*							
VESP5B071991	CL 15026	CT	0.19	ND*							
VESP5C071991	CL 15027	CT	0.22	ND*							
VESP6A071991	CL 15028	CT	0.06	ND*							
VESP6B071991	CL 15029	CT	0.19	ND*							
VESP6C071991	CL 15030	CT	0.25	ND*							
VESP7A071991	CL 15031	CT	ND*	ND*							
VESP7B071991	CL 15032	CT	0.23	ND*							
VESP7C071991	CL 15033	CT	0.24	ND*							
VESP8A071991	CL 15034	CT	ND*	ND*							
VESP8B071991	CL 15035	CT	0.11	ND*							
VESP8C071991	CL 15036	CT	0.11	ND*							
VESDIS071991	CL 15037	CT	ND*	ND*							

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.
** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 3 of 3
Part 1 of 1

Date 7/29/91
Agency Identification Number 91-1959

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample 'A' SECTION	Trichloroethylene mg/sample 'B' SECTION
VES-3-071991	CL 15038	CT	0.16	ND*
VES-1004-P	CL 15039	CT	0.15	ND*
VES-1005	CL 15040	CT	ND*	ND*
TRIP BLANK	CL 15041	CT	ND*	ND*
* Limit of Detection			0.05	0.05

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 8/8/91
Agency Identification Number 91-2024
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Standford Place 3, Suite 1000
Denver, CO 80237
Attention: Jeff Cox

FAX
Telephone (303) 740-2791

Sampling Collection and Shipment

Sampling Site _____ Date of Collection July 24, 1991

Date Samples Received at DataChem July 26, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis July 31, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE A SECTION	Trichloroethylene MG/SAMPLE B SECTION
VES5A072491P	CL 15626	CT	0.01	ND*
VES5B072491P	CL 15627	CT	0.03	ND*
VES5C072491P	CL 15628	CT	0.07	ND*
VES6A072491P	CL 15629	CT	0.03	ND*
VES6B072491P	CL 15630	CT	0.07	ND*
VES6C072491P	CL 15631	CT	0.19	ND*
VES7A072491P	CL 15632	CT	ND*	ND*
VES7B072491P	CL 15633	CT	0.14	ND*
VES7C072491P	CL 15634	CT	0.08	ND*
VES8A072491P	CL 15635	CT	ND*	ND*
VES8B072491P	CL 15636	CT	0.04	ND*
VES8C072491P	CL 15637	CT	ND*	ND*
VES3072491P	CL 15638	CT	0.10	ND*

† See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Dan Bruch
Reviewer: Daniel J. Bruch

Dan Bruch
Laboratory Supervisor: Daniel J. Bruch

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
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DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Page 2 of 2
Part 1 of 1

Date 8/8/91

Agency Identification Number 91-2024

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE A SECTION	Trichloroethylene MG/SAMPLE B SECTION
VESDIS072491	CL 15639	CT	ND*	ND*
VES-1006-P	CL 15640	CT	0.08	ND*
VES-1007	CL 15641	CT	ND*	ND*
TRIP BLANK	CL 15642	CT	ND*	ND*
* Limit of Detection			0.01	0.01

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Form ARF-AL
Page 1 of 4
Part 1 of 1

Date 8/23/91
Agency Identification Number 91-2162
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Standford Place 3, Suite 1000
Denver, CO 80237
Attention: Jeff Cox

FAX
Telephone (303) 740-2791

Sampling Collection and Shipment

Sampling Site _____ Date of Collection July 29, 1991

Date Samples Received at DataChem August 06, 1991

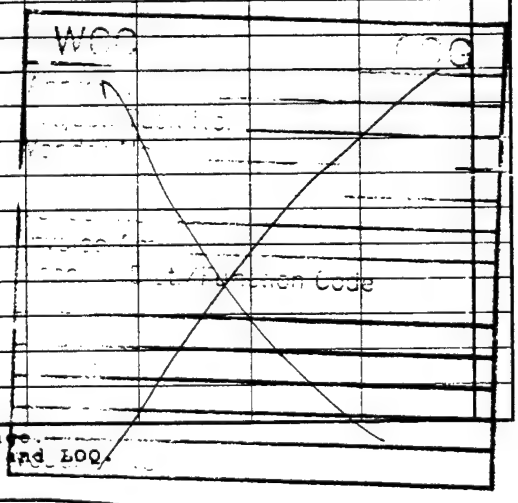
Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis August 15, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID
5A-072991-P	CL 17099	CT	ND*	ND*	ND*
5B-072991-P	CL 17100	CT	0.02	ND*	ND*
5C-072991-P	CL 17101	CT	ND*	ND*	ND*
6A-072991-P	CL 17102	CT	0.01	ND*	ND*
6B-072991-P	CL 17103	CT	0.03	ND*	ND*
6C-072991-P	CL 17104	CT	0.02	ND*	ND*
7A-072991-P	CL 17105	CT	ND*	ND*	ND*
7B-072991-P	CL 17106	CT	0.03	ND*	ND*
7C-072991-P	CL 17107	CT	0.02	ND*	ND*
8A-072991-P	CL 17108	CT	ND*	ND*	ND*
8B-072991-P	CL 17109	CT	0.03	ND*	ND*
8C-072991-P	CL 17110	CT	ND*	ND*	ND*
DIS-072991-P	CL 17111	CT	ND*	ND*	ND*



* See comment on last page.
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NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Jeff R. Scott

F. Rejali
Reviewer: Fred M. Rejali

for NJB
Laboratory Supervisor: Daniel J. Bruch

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 8/23/91

Agency Identification Number 91-2162

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID						
VES4072991-P	CL 17112	CT	0.17	ND*	ND*						
VES-2000-P	CL 17113	CT	ND*	ND*	ND*						
VES-2001	CL 17114	CT	ND*	ND*	ND*						
5A-073191-P	CL 17115	CT	ND*	ND*	ND*						
5B-073191-P	CL 17116	CT	0.01	ND*	ND*						
5C-073191-P	CL 17117	CT	0.04	ND*	ND*						
6A-073191-P	CL 17118	CT	ND*	ND*	ND*						
6B-073191-P	CL 17119	CT	0.02	ND*	ND*						
6C-073191-P	CL 17120	CT	ND*	ND*	ND*						
7A-073191-P	CL 17121	CT	ND*	ND*	ND*						
[illegible]073191-P	CL 17122	CT	ND*	ND*	ND*						
7C-073191-P	CL 17123	CT	0.03	ND*	ND*						
8A-073191-P	CL 17124	CT	ND*	ND*	ND*						
8B-073191-P	CL 17125	CT	0.03	ND*	ND*						
8C-073191-P	CL 17126	CT	0.03	ND*	ND*						
DIS-073191-P	CL 17127	CT	ND*	ND*	ND*						
VES4073191-P	CL 17128	CT	0.19	ND*	ND*						
VES-2002-P	CL 17129	CT	0.03	ND*	ND*						
VES-2003	CL 17130	CT	ND*	ND*	ND*						
5A-080291-P	CL 17131	CT	ND*	ND*	ND*						
5B-080291-P	CL 17132	CT	ND*	ND*	ND*						
5C-080291-P	CL 17133	CT	0.01	ND*	ND*						
6A-080291-P	CL 17134	CT	ND*	ND*	ND*						
6B-080291-P	CL 17135	CT	0.02	ND*	ND*						†
6C-080291-P	CL 17136	CT	0.02	ND*	ND*						
7A-080291-P	CL 17137	CT	ND*	ND*	ND*						
7B-080291-P	CL 17138	CT	ND*	ND*	ND*						
7C-080291-P	CL 17139	CT	0.02	ND*	ND*						
8A-080291-P	CL 17140	CT	ND*	ND*	ND*						
8B-080291-P	CL 17141	CT	0.03	ND*	ND*						

* See comment on last page. ** See comment on last page.
ND Parameter not detected. ( ) Parameter between LOD and LOQ.
NR Parameter not requested.

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 3 of 4
Part 1 of 1

Date 3/23/91
Agency Identification Number 91-2162

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID					
8C-080291-P	CL 17142	CT	ND*	ND*	ND*					
VES-2004-P	CL 17143	CT	0.02	ND*	ND*					
VES4080291-P	CL 17144	CT	0.13	ND*	ND*					
DIS-080291-P	CL 17145	CT	ND*	ND*	ND*					
VES-2005	CL 17146	CT	ND*	ND*	ND*					
TRIP BLANK	CL 17147	CT	ND*	ND*	ND*					
* Limit of Detection			0.01	0.01	0.001					

† See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 8/23/91

Agency Identification Number 91-2162

Sample Comments

DataChem Lab Number	-- Comment --
CL 17135	B-SECTION CONTAINED >30% OF REPORTED AMOUNT OF TRICHLOROETHYLENE.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

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AUG 2 8 1991
WCC/DENVER, COLORADO

Date 8/23/91
Agency Identification Number 91-2217
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection August 07, 1991

Date Samples Received at DataChem August 09, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis August 16, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID
VES5A080791P	CL 17746	CT	ND*	ND*	ND*
VES5B080791P	CL 17747	CT	ND*	ND*	ND*
VES5C080791P	CL 17748	CT	0.01	ND*	ND*
VES6A080791P	CL 17749	CT	ND*	ND*	ND*
VES6B080791P	CL 17750	CT	0.02	ND*	ND*
VES6C080791P	CL 17751	CT	0.02	ND*	ND*
VES7A080791P	CL 17752	CT	ND*	ND*	ND*
VES7B080791P	CL 17753	CT	ND*	ND*	ND*
VES7C080791P	CL 17754	CT	0.02	ND*	ND*
VES8A080791P	CL 17755	CT	ND*	ND*	ND*
VES8B080791P	CL 17756	CT	0.04	ND*	ND*
VES8C080791P	CL 17757	CT	0.11	ND*	ND*
VES4080791-P	CL 17758	CT	0.08	ND*	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Jeff R. Scott

Reviewer: Fred M. Rejali

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Page 2 of 2
Part 1 of 1

Date 8/23/91
Agency Identification Number 91-2217

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID					
VESDIS080791	CL 17759	CT	ND*	ND*	ND*					
VES-2006-P	CL 17760	CT	ND*	ND*	ND*					
VES-2007-P	CL 17761	CT	ND*	ND*	ND*					
TRIP BLANK	CL 17762	CT	ND*	ND*	ND*					
* Limit of Detection			0.01	0.01	0.001					

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Page 1 of 2
Part 1 of 1

Date 8/30/91
Agency Identification Number 91-2499
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection August 12, 1991

Date Samples Received at DataChem August 14, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis August 26, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethylene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID
VES5A081291P	CL 18144	CT	ND*	ND*	ND*
VES5B081291P	CL 18145	CT	ND*	ND*	ND*
VES5C081291P	CL 18146	CT	0.04	ND*	ND*
VES6A081291P	CL 18147	CT	ND*	ND*	ND*
VES6B081291P	CL 18148	CT	ND*	ND*	ND*
VES6C081291P	CL 18149	CT	ND*	ND*	ND*
VES7A081291P	CL 18150	CT	ND*	ND*	ND*
VES7B081291P	CL 18151	CT	ND*	ND*	ND*
VES7C081291P	CL 18152	CT	ND*	ND*	ND*
VES8A081291P	CL 18153	CT	ND*	ND*	ND*
VES8B081291P	CL 18154	CT	ND*	ND*	ND*
VES8C081291P	CL 18155	CT	0.03	ND*	ND*
DIS-081291-P	CL 18156	CT	ND*	ND*	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Jeff R. Scott

Reviewer: Fred M. Rejali

Laboratory Supervisor: Daniel J. Bruch

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 8/30/91

Agency Identification Number 91-2499

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethylene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID
VES3081291P	CL 18157	CT	0.05	ND*	ND*
VES-3000-P	CL 18158	CT	ND*	ND*	ND*
VES-3001	CL 18159	CT	ND*	ND*	ND*
TRIP BLANK	CL 18160	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 9/5/91
Agency Identification Number 91-2630
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection August 19, 1991

Date Samples Received at DataChem August 26, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis August 30, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
5A-081991-P	CL 19351	CT	ND*	ND*	ND*
5B-081991-P	CL 19352	CT	0.01	ND*	ND*
5C-081991-P	CL 19353	CT	ND*	ND*	ND*
6A-081991-P	CL 19354	CT	ND*	ND*	ND*
6B-081991-P	CL 19355	CT	0.01	ND*	ND*
6C-081991-P	CL 19356	CT	0.04	ND*	ND*
7A-081991-P	CL 19357	CT	ND*	ND*	ND*
7B-081991-P	CL 19358	CT	0.03	ND*	ND*
7C-081991-P	CL 19359	CT	0.03	ND*	ND*
8A-081991-P	CL 19360	CT	ND*	ND*	ND*
8B-081991-P	CL 19361	CT	0.01	ND*	ND*
8C-081991-P	CL 19362	CT	0.03	ND*	ND*
VES3081991P	CL 19363	CT	0.05	ND*	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 9/5/91

Agency Identification Number 91-2630

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
DIS-081991-P	CL 19364	CT	ND*	ND*	ND*
VES-3002-P	CL 19365	CT	ND*	ND*	ND*
VES-3003	CL 19366	CT	ND*	ND*	ND*
TRIP BLANK	CL 19367	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 9/17/91
Agency Identification Number 91-2715
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection August 26, 1991

Date Samples Received at DataChem September 03, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis September 12, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID					
VES5A082691P	CL 20127	CT	ND*	ND*	ND*					
VES5B082691P	CL 20128	CT	0.03	ND*	ND*					
VES5C082691P	CL 20129	CT	0.01	ND*	ND*					
VES6A082691P	CL 20130	CT	ND*	ND*	ND*					
VES6B082691P	CL 20131	CT	0.02	ND*	ND*					
VES6C082691P	CL 20132	CT	ND*	ND*	ND*					
VES7A082691P	CL 20133	CT	ND*	ND*	ND*					
VES7B082691P	CL 20134	CT	0.02	ND*	ND*					
VES7C082691P	CL 20135	CT	ND*	ND*	ND*					
VES8A082691P	CL 20136	CT	ND*	ND*	ND*					
VES8B082691P	CL 20137	CT	0.02	ND*	ND*					
VES8C082691P	CL 20138	CT	ND*	ND*	ND*					
VES3082691P	CL 20139	CT	0.05	ND*	ND*					

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Jeff R. Scott
Reviewer: Jeff R. Scott

Daniel J. Bruch
Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 9/17/91
Agency Identification Number 91-2715

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
VESDIS082691	CL 20140	CT	ND*	ND*	ND*
VES-3004-P	CL 20141	CT	0.02	ND*	ND*
VES-3005	CL 20142	CT	ND*	ND*	ND*
VES5A083091P	CL 20143	CT	ND*	ND*	ND*
VES5B083091P	CL 20144	CT	0.03	ND*	ND*
VES5C083091P	CL 20145	CT	ND*	ND*	ND*
VES6A083091P	CL 20146	CT	ND*	ND*	ND*
VES6B083091P	CL 20147	CT	0.02	ND*	ND*
VES6C083091P	CL 20148	CT	0.01	ND*	ND*
VES7A083091P	CL 20149	CT	ND*	ND*	ND*
VES7B083091P	CL 20150	CT	0.03	ND*	ND*
VES7C083091P	CL 20151	CT	0.03	ND*	ND*
VES8A083091P	CL 20152	CT	ND*	ND*	ND*
VES8B083091P	CL 20153	CT	0.01	ND*	ND*
VES8C083091P	CL 20154	CT	0.02	ND*	ND*
VES-4000-P	CL 20155	CT	0.03	ND*	ND*
VES-4001	CL 20156	CT	ND*	ND*	ND*
TRIP BLANK	CL 20157	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 9/17/91
Agency Identification Number 91-2776
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection September 03, 1991

Date Samples Received at DataChem September 05, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis September 12, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
5A-090391-P	CL 20593	CT	ND*	ND*	ND*
5B-090391-P	CL 20594	CT	0.01	ND*	ND*
5C-090391-P	CL 20595	CT	0.02	ND*	ND*
6A-090391-P	CL 20596	CT	ND*	ND*	ND*
6B-090391-P	CL 20597	CT	ND*	ND*	ND*
6C-090391-P	CL 20598	CT	0.01	ND*	ND*
7A-090391-P	CL 20599	CT	ND*	ND*	ND*
7B-090391-P	CL 20600	CT	ND*	ND*	ND*
7C-090391-P	CL 20601	CT	0.11	ND*	ND*
8A-090391-P	CL 20602	CT	ND*	ND*	ND*
8B-090391-P	CL 20603	CT	0.01	ND*	ND*
8C-090391-P	CL 20604	CT	ND*	ND*	ND*
DIS-090391-P	CL 20605	CT	ND*	ND*	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 9/17/91
Agency Identification Number 91-2776

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
VES4-090391P	CL 20606	CT	0.12	ND*	ND*
VES-5000-P	CL 20607	CT	0.10	ND*	ND*
VES-5001	CL 20608	CT	ND*	ND*	ND*
TRIP BLANK	CL 20609	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 9/17/91
Agency Identification Number 91-2824
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection September 09, 1991

Date Samples Received at DataChem September 10, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis September 12, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
5A-090991-B	CL 20879	CT	ND*	ND*	ND*
5B-090991-B	CL 20880	CT	ND*	ND*	ND*
5C-090991-B	CL 20881	CT	ND*	ND*	ND*
6A-090991-B	CL 20882	CT	ND*	ND*	ND*
6B-090991-B	CL 20883	CT	ND*	ND*	ND*
6C-090991-B	CL 20884	CT	ND*	ND*	ND*
7A-090991-B	CL 20885	CT	ND*	ND*	ND*
7B-090991-B	CL 20886	CT	ND*	ND*	ND*
7C-090991-B	CL 20887	CT	ND*	ND*	ND*
8A-090991-B	CL 20888	CT	ND*	ND*	ND*
8B-090991-B	CL 20889	CT	ND*	ND*	ND*
8C-090991-B	CL 20890	CT	ND*	ND*	ND*
DIS-090991-B	CL 20891	CT	ND*	ND*	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 9/17/91

Agency Identification Number 91-2824

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
VES4-090991B	CL 20892	CT	ND*	ND*	ND*
VES-5002-B	CL 20893	CT	ND*	ND*	ND*
5A-090991-P	CL 20894	CT	ND*	ND*	ND*
5B-090991-P	CL 20895	CT	ND*	ND*	ND*
5C-090991-P	CL 20896	CT	0.01	ND*	ND*
6A-090991-P	CL 20897	CT	ND*	ND*	ND*
6B-090991-P	CL 20898	CT	ND*	ND*	ND*
6C-090991-P	CL 20899	CT	0.01	ND*	ND*
7A-090991-P	CL 20900	CT	ND*	ND*	ND*
7B-090991-P	CL 20901	CT	ND*	ND*	ND*
7C-090991-P	CL 20902	CT	ND*	ND*	ND*
8A-090991-P	CL 20903	CT	ND*	ND*	ND*
8B-090991-P	CL 20904	CT	ND*	ND*	ND*
8C-090991-P	CL 20905	CT	0.03	ND*	ND*
DIS-090991-P	CL 20906	CT	ND*	ND*	ND*
VES4-090991P	CL 20907	CT	0.08	ND*	ND*
VES-5002-P	CL 20908	CT	0.05	ND*	ND*
TRIP BLANK	CL 20909	CT	ND*	ND*	ND*
VES-5003	CL 20910	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Page 1 of 2
Part 1 of 1

Date 9/23/91
Agency Identification Number 91-2912
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection September 16, 1991

Date Samples Received at DataChem September 17, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis September 20, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID					
5A-091691-P	CL 21465	CT	ND*	ND*	ND*					
5B-091691-P	CL 21466	CT	ND*	ND*	ND*					
5C-091691-P	CL 21467	CT	ND*	ND*	ND*					
6A-091691-P	CL 21468	CT	ND*	ND*	ND*					
6B-091691-P	CL 21469	CT	ND*	ND*	ND*					
6C-091691-P	CL 21470	CT	ND*	ND*	ND*					
7A-091691-P	CL 21471	CT	ND*	ND*	ND*					
7B-091691-P	CL 21472	CT	ND*	ND*	ND*					
7C-091691-P	CL 21473	CT	ND*	ND*	ND*					
8A-091691-P	CL 21474	CT	ND*	ND*	ND*					
8B-091691-P	CL 21475	CT	ND*	ND*	ND*					
8C-091691-P	CL 21476	CT	ND*	ND*	ND*					
VES4-091691P	CL 21477	CT	0.07	ND*	ND*					

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 9/23/91
Agency Identification Number 91-2912

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
DIS-091691-P	CL 21478	CT	ND*	ND*	ND*
VES-5004-P	CL 21479	CT	ND*	ND*	ND*
VES-5005	CL 21480	CT	ND*	ND*	ND*
TRIP BLANK	CL 21481	CT	ND*	ND*	ND*
5A-091691-B	CL 21482	CT	ND*	ND*	ND*
5B-091691-B	CL 21483	CT	ND*	ND*	ND*
5C-091691-B	CL 21484	CT	ND*	ND*	ND*
6A-091691-B	CL 21485	CT	ND*	ND*	ND*
6B-091691-B	CL 21486	CT	ND*	ND*	ND*
6C-091691-B	CL 21487	CT	ND*	ND*	ND*
7A-091691-B	CL 21488	CT	ND*	ND*	ND*
7B-091691-B	CL 21489	CT	ND*	ND*	ND*
7C-091691-B	CL 21490	CT	ND*	ND*	ND*
8A-091691-B	CL 21491	CT	ND*	ND*	ND*
8B-091691-B	CL 21492	CT	ND*	ND*	ND*
8C-091691-B	CL 21493	CT	ND*	ND*	ND*
VES4-091691B	CL 21494	CT	ND*	ND*	ND*
VES-5004-B	CL 21495	CT	ND*	ND*	ND*
DIS-091691-B	CL 21496	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 10/8/91
Agency Identification Number 91-2985
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection September 20, 1991

Date Samples Received at DataChem September 24, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis September 28, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethylene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID
5A-092091-P	CL 21942	CT	ND*	ND*	ND*
5B-092091-P	CL 21943	CT	ND*	ND*	ND*
5C-092091-P	CL 21944	CT	ND*	ND*	ND*
6A-092091-P	CL 21945	CT	ND*	ND*	ND*
6B-092091-P	CL 21946	CT	ND*	ND*	ND*
6C-092091-P	CL 21947	CT	0.02	ND*	ND*
7A-092091-P	CL 21948	CT	ND*	ND*	ND*
7B-092091-P	CL 21949	CT	ND*	ND*	ND*
8A-092091-P	CL 21950	CT	ND*	ND*	ND*
8B-092091-P	CL 21951	CT	0.01	ND*	ND*
8C-092091-P	CL 21952	CT	ND*	ND*	ND*
7C-092091-P	CL 21953	CT	0.03	ND*	ND*
VES-5006-P	CL 21954	CT	ND*	ND*	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Jeff R. Scott
Reviewer: Jeff R. Scott

Dan Bruch
Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 10/8/91

Agency Identification Number 91-2985

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethylene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID
VES-5005	CL 21955	CT	ND*	ND*	ND*
5A-092091-B	CL 21956	CT	ND*	ND*	ND*
5B-092091-B	CL 21957	CT	ND*	ND*	ND*
5C-092091-B	CL 21958	CT	ND*	ND*	ND*
6A-092091-B	CL 21959	CT	ND*	ND*	ND*
6B-092091-B	CL 21960	CT	ND*	ND*	ND*
6C-092091-B	CL 21961	CT	ND*	ND*	ND*
7A-092091-B	CL 21962	CT	ND*	ND*	ND*
7B-092091-B	CL 21963	CT	ND*	ND*	ND*
7C-092091-B	CL 21964	CT	ND*	ND*	ND*
8A-092091-B	CL 21965	CT	ND*	ND*	ND*
8B-092091-B	CL 21966	CT	ND*	ND*	ND*
8C-092091-B	CL 21967	CT	ND*	ND*	ND*
VES-5006-B	CL 21968	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 10/8/91
Agency Identification Number 91-3022
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection September 23, 1991

Date Samples Received at DataChem September 27, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis September 28, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID	1,2-Dichloroethylene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID					
5A-092391-P	CL 22260	CT	ND*	ND*	ND*					
5B-092391-P	CL 22261	CT	0.02	ND*	ND*					
5C-092391-P	CL 22262	CT	0.02	ND*	ND*					
6A-092391-P	CL 22263	CT	ND*	ND*	ND*					
6B-092391-P	CL 22264	CT	ND*	ND*	ND*					
6C-092391-P	CL 22265	CT	0.04	ND*	ND*					
7A-092391-P	CL 22266	CT	ND*	ND*	ND*					
7B-092391-P	CL 22267	CT	ND*	ND*	ND*					
7C-092391-P	CL 22268	CT	ND*	ND*	ND*					
8A-092391-P	CL 22269	CT	ND*	ND*	ND*					
8B-092391-P	CL 22270	CT	0.01	ND*	ND*					
8C-092391-P	CL 22271	CT	0.03	ND*	ND*					
VES3-092391P	CL 22272	CT	0.10	ND*	ND*					

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Page 2 of 2
Part 1 of 1

Date 10/8/91

Agency Identification Number 91-3022

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloro ethylene mg/sample GC/FID	1,2-Dichloro ethylene mg/sample GC/FID	Vinyl Chloride mg/sample GC/FID					
DIS-092391-P	CL 22273	CT	ND*	ND*	ND*					
VES-5008-P	CL 22274	CT	ND*	ND*	ND*					
VES-5009	CL 22275	CT	ND*	ND*	ND*					
* Limit of Detection			0.01	0.01	0.001					

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 10/14/91
Agency Identification Number 91-3087
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection October 01, 1991

Date Samples Received at DataChem October 03, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis October 06, 1991 - October 07, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloro ethylene MG/SAMPLE GC/FID	1,2-Dichloro ethylene MG/SAMPLE GC/FID	vinyl Chloride MG/SAMPLE GC/FID					
5A-100191-P	CL 22904	CT	ND*	ND*	ND*					
5B-100191-P	CL 22905	CT	0.03	ND*	ND*					
5C-100191-P	CL 22906	CT	0.07	ND*	ND*					
6A-100191-P	CL 22907	CT	ND*	ND*	ND*					
6B-100191-P	CL 22908	CT	0.04	ND*	ND*					
6C-100191-P	CL 22909	CT	0.11	ND*	ND*					
7A-100191-P	CL 22910	CT	ND*	ND*	ND*					
7B-100191-P	CL 22911	CT	0.04	ND*	ND*					
7C-100191-P	CL 22912	CT	0.09	ND*	ND*					
8A-100191-P	CL 22913	CT	ND*	ND*	ND*					
8B-100191-P	CL 22914	CT	0.03	ND*	ND*					
8C-100191-P	CL 22915	CT	ND*	ND*	ND*					
VES-5010-P	CL 22916	CT	0.08	ND*	ND*					

† See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 10/14/91
Agency Identification Number 91-3087

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID					
VES3-100191P	CL 22917	CT	0.08	ND*	ND*					
DIS-100191-P	CL 22918	CT	ND*	ND*	ND*					
VES-5011	CL 22919	CT	ND*	ND*	ND*					
* Limit of Detection			0.01	0.01	0.001					

† See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 10/15/91
Agency Identification Number 91-3141
Account No. 03019

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4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection October 07, 1991

Date Samples Received at DataChem October 08, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis October 12, 1991 - October 13, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID					
5A-100791-P	CL 23344	CT	ND*	ND*	ND*					
5B-100791-P	CL 23345	CT	0.04	ND*	ND*					
5C-100791-P	CL 23346	CT	0.02	ND*	ND*					
6A-100791-P	CL 23347	CT	ND*	ND*	ND*					
6B-100791-P	CL 23348	CT	0.05	ND*	ND*					
6C-100791-P	CL 23349	CT	0.08	ND*	ND*					
7A-100791-P	CL 23350	CT	ND*	ND*	ND*					
7B-100791-P	CL 23351	CT	0.06	ND*	ND*					
7C-100791-P	CL 23352	CT	0.13	ND*	ND*					
8A-100791-P	CL 23353	CT	ND*	ND*	ND*					
8B-100791-P	CL 23354	CT	0.03	ND*	ND*					
8C-100791-P	CL 23355	CT	0.09	ND*	ND*					
VES3100791-P	CL 23356	CT	0.09	ND*	ND*					

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.
** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 10/15/91

Agency Identification Number 91-3141

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID					
DIS-100791-P	CL 23357	CT	ND*	ND*	ND*					
VES-5012-P	CL 23358	CT	0.15	ND*	ND*					
VES-5013	CL 23359	CT	ND*	ND*	ND*					
* Limit of Detection			0.01	0.01	0.001					

- See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 10/24/91
Agency Identification Number 91-3229
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection October 11, 1991

Date Samples Received at DataChem October 16, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis October 20, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID					
5A-101191-P	CL 24395	CT	ND*	ND*	ND*					
5B-101191-P	CL 24396	CT	0.03	ND*	ND*					
5C-101191-P	CL 24397	CT	0.09	ND*	ND*					
6A-101191-P	CL 24398	CT	ND*	ND*	ND*					
6B-101191-P	CL 24399	CT	0.04	ND*	ND*					
6C-101191-P	CL 24400	CT	0.12	ND*	ND*					
7A-101191-P	CL 24401	CT	ND*	ND*	ND*					
7B-101191-P	CL 24402	CT	0.04	ND*	ND*					
7C-101191-P	CL 24403	CT	0.11	ND*	ND*					
8A-101191-P	CL 24404	CT	ND*	ND*	ND*					
8B-101191-P	CL 24405	CT	ND*	ND*	ND*					
8C-101191-P	CL 24406	CT	0.09	ND*	ND*					
VES-5014-P	CL 24407	CT	0.12	ND*	ND*					

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: F. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 10/24/91
Agency Identification Number 91-3229

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
VES-5015	CL 24408	CT	ND*	ND*	ND*
TRIP BLANK	CL 24409	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 10/24/91
Agency Identification Number 91-3230
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection October 15, 1991

Date Samples Received at DataChem October 16, 1991

Analysis

Method of Analysis NIOSH 1003, NIOSH 1007, NIOSH 1022

Date(s) of Analysis October 20, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
5A-101591-P	CL 24410	CT	ND*	ND*	ND*
5B-101591-P	CL 24411	CT	0.02	ND*	ND*
5C-101591-P	CL 24412	CT	0.04	ND*	ND*
6A-101591-P	CL 24413	CT	ND*	ND*	ND*
6B-101591-P	CL 24414	CT	0.02	ND*	ND*
6C-101591-P	CL 24415	CT	0.07	ND*	ND*
7A-101591-P	CL 24416	CT	ND*	ND*	ND*
7B-101591-P	CL 24417	CT	0.02	ND*	ND*
7C-101591-P	CL 24418	CT	ND*	ND*	ND*
8A-101591-P	CL 24419	CT	ND*	ND*	ND*
8B-101591-P	CL 24420	CT	0.02	ND*	ND*
8C-101591-P	CL 24421	CT	0.12	ND*	ND*
DIS-101591-P	CL 24422	CT	ND*	ND*	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst:

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 10/24/91

Agency Identification Number 91-3230

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID	1,2-Dichloroethylene MG/SAMPLE GC/FID	Vinyl Chloride MG/SAMPLE GC/FID
VES4-101591P	CL 24423	CT	0.07	ND*	ND*
VES-5018-P	CL 24424	CT	0.11	ND*	ND*
VES-5017	CL 24425	CT	ND*	ND*	ND*
* Limit of Detection			0.01	0.01	0.001

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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ANALYTICAL REPORT

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Part 1 of 1

Date 11/1/91
Agency Identification Number 91-3369
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection October 21, 1991

Date Samples Received at DataChem October 25, 1991

Analysis

Method of Analysis GC/FID

Date(s) of Analysis October 28, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
5A-102191-P	CL 25551	CT	ND*
5B-102191-P	CL 25552	CT	ND*
5C-102191-P	CL 25553	CT	0.03
6A-102191-P	CL 25554	CT	ND*
6B-102191-P	CL 25555	CT	ND*
6C-102191-P	CL 25556	CT	ND*
7A-102191-P	CL 25557	CT	ND*
7B-102191-P	CL 25558	CT	ND*
7C-102191-P	CL 25559	CT	ND*
8A-102191-P	CL 25560	CT	ND*
8B-102191-P	CL 25561	CT	ND*
8C-102191-P	CL 25562	CT	ND*
DIS-102191-P	CL 25563	CT	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Young Hee Yoon
Analyst: Young Hee Yoon

Dan Bruch
Reviewer:

Dan Bruch
Laboratory Supervisor:

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Page 2 of 2
Part 1 of 1

Date 11/1/91

Agency Identification Number 91-3369

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
VES4-102191P	CL 25564	CT	0.08
VES-5018-P	CL 25565	CT	ND*
VES-5019	CL 25566	CT	ND*
* Limit of Detection			0.01

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
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Date 11/1/91
Agency Identification Number 91-3395
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection October 28, 1991

Date Samples Received at DataChem October 29, 1991

Analysis

Method of Analysis GC/FID

Date(s) of Analysis October 30, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
5A-102891-P	CL 25734	CT	ND*
5B-102891-P	CL 25735	CT	ND*
5C-102891-P	CL 25736	CT	ND*
6A-102891-P	CL 25737	CT	ND*
6B-102891-P	CL 25738	CT	ND*
6C-102891-P	CL 25739	CT	ND*
7A-102891-P	CL 25740	CT	ND*
7B-102891-P	CL 25741	CT	ND*
7C-102891-P	CL 25742	CT	ND*
8A-102891-P	CL 25743	CT	ND*
8B-102891-P	CL 25744	CT	0.02
8C-102891-P	CL 25745	CT	ND*
VES4-102891P	CL 25746	CT	0.07

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Young Hee Yoon
Analyst:

Dan Bruch
Reviewer:

Dan Bruch
Laboratory Supervisor:

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Part 1 of 1

Date 11/1/91
Agency Identification Number 91-3395

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
DIS-102891-P	CL 25747	CT	ND*
VES-5020-P	CL 25748	CT	ND*
VES-5021	CL 25749	CT	ND*
* Limit of Detection			0.01

See comment on last page.
Parameter not detected.
Parameter not requested.

** See comment on last page.
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Date 11/8/91
Agency Identification Number 91-3448
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection November 01, 1991

Date Samples Received at DataChem November 04, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis November 06, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample								
5A-110191-P	CL 26158	CT	ND*								
5B-110191-P	CL 26159	CT	ND*								
5C-110191-P	CL 26160	CT	ND*								
6A-110191-P	CL 26161	CT	ND*								
6B-110191-P	CL 26162	CT	ND*								
6C-110191-P	CL 26163	CT	ND*								
7A-110191-P	CL 26164	CT	ND*								
7B-110191-P	CL 26165	CT	ND*								
7C-110191-P	CL 26166	CT	ND*								
8A-110191-P	CL 26167	CT	ND*								
8B-110191-P	CL 26168	CT	ND*								
8C-110191-P	CL 26169	CT	ND*								
VES-5022-P	CL 26170	CT	ND*								

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Lawrence E. Miller

Reviewer: Dan Bruch

Laboratory Supervisor: Dan Bruch

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Page 2 of 2
Part 1 of 1

Date 11/8/91

Agency Identification Number 91-3448

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample							
VES-5023	CL 26171	CT	ND*							
* Limit of Detection			0.01							

See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
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Date 11/18/91
Agency Identification Number 91-3494
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection November 04, 1991

Date Samples Received at DataChem November 07, 1991

Analysis

Method of Analysis GC/FID

Date(s) of Analysis November 10, 1991 - November 13, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
5A-110491-P	CL 26482	CT	ND*
5B-110491-P	CL 26483	CT	ND*
5C-110491-P	CL 26484	CT	ND*
6A-110491-P	CL 26485	CT	ND*
6B-110491-P	CL 26486	CT	ND*
6C-110491-P	CL 26487	CT	ND*
7A-110491-P	CL 26488	CT	ND*
7B-110491-P	CL 26489	CT	ND*
7C-110491-P	CL 26490	CT	ND*
8A-110491-P	CL 26491	CT	ND*
8B-110491-P	CL 26492	CT	ND*
8C-110491-P	CL 26493	CT	ND*
VES4-110491P	CL 26494	CT	0.08

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Amy Jo Jensen

Reviewer: Pamela Johnson

Laboratory Supervisor: Daniel J. Bruch

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Date 11/18/91

Agency Identification Number 91-3494

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
DIS-110491-P	CL 26495	CT	ND*
VES-5024-P	CL 26496	CT	0.03
VES-5025	CL 26497	CT	ND*
* Limit of Detection			0.01

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

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DataChem Laboratories

Quality Control Data Sheet

Batch ID 1991-6084

Analyte	Trichloroethylene	Matrix	
Analyst Name	JENSEN_A	Instrument	
Analyst Number	5351	Date	14-NOV-1991 14:57
Method	GC/FID		
Results in	mg/sample		

Sample #		Values	Mean	Target	Range	Range/Mean	Status
BLANK	2	-0.0012	Below Range				
		-0.0012	Below Range				
CL 26482A	2	-0.0012	Below Range				
		-0.0012	Below Range				
CL 26488A	2	0.0029	Below Range				
		0.0029	Below Range				
QC40579	2	0.2795	0.2793	0.2750	0.0004	0.0013	I I
		0.2791					
QC40583	2	0.5390	0.5397	0.5490	0.0014	0.0027	I I
		0.5404					

11/18/91

Page 1 Limit of detection: ~~7.7200E-01~~ 0.01 mg/sample Checked by: PJ

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Date 11/19/91
Agency Identification Number 91-3549
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection November 11, 1991

Date Samples Received at DataChem November 12, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis November 16, 1991 - November 17, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample								
5A-111191-P	CL 27241	CT	ND*								
5B-111191-P	CL 27242	CT	ND*								
5C-111191-P	CL 27243	CT	ND*								
6A-111191-P	CL 27244	CT	ND*								
6B-111191-P	CL 27245	CT	ND*								
6C-111191-P	CL 27246	CT	ND*								
7A-111191-P	CL 27247	CT	ND*								
7B-111191-P	CL 27248	CT	ND*								
7C-111191-P	CL 27249	CT	ND*								
8A-111191-P	CL 27250	CT	ND*								
8B-111191-P	CL 27251	CT	ND*								
8C-111191-P	CL 27252	CT	ND*								
VES4-111191P	CL 27253	CT	0.08								

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Lawrence E. Miller

Reviewer:

Laboratory Supervisor:

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ANALYTICAL REPORT

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Date 11/19/91
Agency Identification Number 91-3549

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
DIS-111191-P	CL 27254	CT	ND*
TRIP BLANK	CL 27255	CT	ND*
FIELD BLANK	CL 27256	CT	ND*
* Limit of Detection			0.01

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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ANALYTICAL REPORT

Date 11/27/91
Agency Identification Number 91-3603
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection November 18, 1991

Date Samples Received at DataChem November 20, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis November 22, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample							
5A-111891-P	CL 27607	CT	ND*							
5B-111891-P	CL 27608	CT	ND*							
5C-111891-P	CL 27609	CT	ND*							
6A-111891-P	CL 27610	CT	ND*							
6B-111891-P	CL 27611	CT	ND*							
6C-111891-P	CL 27612	CT	ND*							
7A-111891-P	CL 27613	CT	ND*							
7B-111891-P	CL 27614	CT	ND*							
7C-111891-P	CL 27615	CT	ND*							
8A-111891-P	CL 27616	CT	ND*							
8B-111891-P	CL 27617	CT	ND*							
8C-111891-P	CL 27618	CT	ND*							
VES4-111891P	CL 27619	CT	0.07							

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Paul C. Gillespie

Reviewer: Dan Bruch

Laboratory Supervisor: Dan Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 11/27/91

Agency Identification Number 91-3603

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample
DIS-111891-P	CL 27620	CT	ND*
VES-5028	CL 27621	CT	ND*
TRIP BLANK	CL 27622	CT	ND*
* Limit of Detection			0.02

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

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( ) Parameter between LOD and LOQ.

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1991

Date 12/11/91
Agency Identification Number 91-3713
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection December 02, 1991

Date Samples Received at DataChem December 04, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis December 06, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID
5A-120291-P	CL 28419	CT	ND*
5B-120291-P	CL 28420	CT	ND*
5C-120291-P	CL 28421	CT	ND*
6A-120291-P	CL 28422	CT	ND*
6B-120291-P	CL 28423	CT	ND*
6C-120291-P	CL 28424	CT	ND*
7A-120291-P	CL 28425	CT	ND*
7B-120291-P	CL 28426	CT	ND*
7C-120291-P	CL 28427	CT	0.06
8A-120291-P	CL 28428	CT	ND*
8B-120291-P	CL 28429	CT	0.01
8C-120291-P	CL 28430	CT	0.08
DIS-120291-P	CL 28431	CT	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 12/11/91
Agency Identification Number 91-3713

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID
VES4-120291P	CL 28432	CT	0.08
VES-5030-P	CL 28433	CT	ND*
VES-5031	CL 28434	CT	ND*
* Limit of Detection			0.01

See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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Date 12/16/91
Agency Identification Number 91-3757
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection December 09, 1991

Date Samples Received at DataChem December 10, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis December 14, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID							
5A-120991-P	CL 28834	CT	ND*							
5B-120991-P	CL 28835	CT	ND*							
5C-120991-P	CL 28836	CT	ND*							
6A-120991-P	CL 28837	CT	ND*							
6B-120991-P	CL 28838	CT	ND*							
6C-120991-P	CL 28839	CT	ND*							
7A-120991-P	CL 28840	CT	ND*							
7B-120991-P	CL 28841	CT	ND*							
7C-120991-P	CL 28842	CT	0.03							
8A-120991-P	CL 28843	CT	ND*							
8B-120991-P	CL 28844	CT	ND*							
8C-120991-P	CL 28845	CT	0.02							
VES4-120991P	CL 28846	CT	0.05							

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Jeff Scott
Reviewer: Jeff R. Scott

Dan Bruch
Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-BL
Page 2 of 2
Part 1 of 1

Date 12/16/91

Agency Identification Number 91-3757

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene mg/sample GC/FID
DIS-120991-P	CL 28847	CT	ND*
VES-5032-P	CL 28848	CT	0.01
VES-5033	CL 28849	CT	ND*
* Limit of Detection			0.01

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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ANALYTICAL REPORT

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Date 12/23/91
Agency Identification Number 91-3871
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

FAX
Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection December 10, 1991

Date Samples Received at DataChem December 17, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis December 21, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID
1S-121091-P	CL 30189	CT	ND*
1M-121091-P	CL 30190	CT	0.39
1D-121091-P	CL 30191	CT	0.66
2S-121091-P	CL 30192	CT	0.42
2M-121091-P	CL 30193	CT	0.01
2D-121091-P	CL 30194	CT	1.1
3S-121091-P	CL 30195	CT	0.11
3M-121091-P	CL 30196	CT	0.48
3D-121091-P	CL 30197	CT	1.2
4S-121091-P	CL 30198	CT	ND*
4M-121091-P	CL 30199	CT	0.32
4D-121091-P	CL 30200	CT	0.03
5S-121291-P	CL 30201	CT	ND*

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewed: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 12/23/91

Agency Identification Number 91-3871

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID
5M-121291-P	CL 30202	CT	ND*
5D-121291-P	CL 30203	CT	0.06
* Limit of Detection			0.01

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
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Date 12/23/91
Agency Identification Number 91-3860
Account No. 03019

Woodward-Clyde Consultants
4582 South Ulster Street Parkway
Stanford Place 3, Suite 1000
Denver, CO 80237
Attention: Rich Scheig

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Telephone (303) 694-2770

Sampling Collection and Shipment

Sampling Site _____ Date of Collection December 16, 1991

Date Samples Received at DataChem December 17, 1991

Analysis

Method of Analysis NIOSH 1022

Date(s) of Analysis December 20, 1991 - December 21, 1991

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID
5A-121691-P	CL 30124	CT	ND*
5B-121691-P	CL 30125	CT	ND*
5C-121691-P	CL 30126	CT	ND*
6A-121691-P	CL 30127	CT	ND*
6B-121691-P	CL 30128	CT	ND*
6C-121691-P	CL 30129	CT	ND*
7A-121691-P	CL 30130	CT	ND*
7B-121691-P	CL 30131	CT	ND*
7C-121691-P	CL 30132	CT	0.01
8A-121691-P	CL 30133	CT	ND*
8B-121691-P	CL 30134	CT	ND*
8C-121691-P	CL 30135	CT	0.02
VES4-121691P	CL 30136	CT	0.08

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

F. Rejali
Analyst: Fred M. Rejali

Reviewer: Jeff R. Scott

Laboratory Supervisor: Daniel J. Bruch

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

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Part 1 of 1

Date 12/23/91
Agency Identification Number 91-3860

Analytical Results

Field Sample Number	DataChem Lab Number	Sample Type	Trichloroethylene MG/SAMPLE GC/FID
DIS-121691-P	CL 30137	CT	ND*
VES-5034-P	CL 30138	CT	ND*
VES-5035	CL 30139	CT	ND*
* Limit of Detection			0.01

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

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